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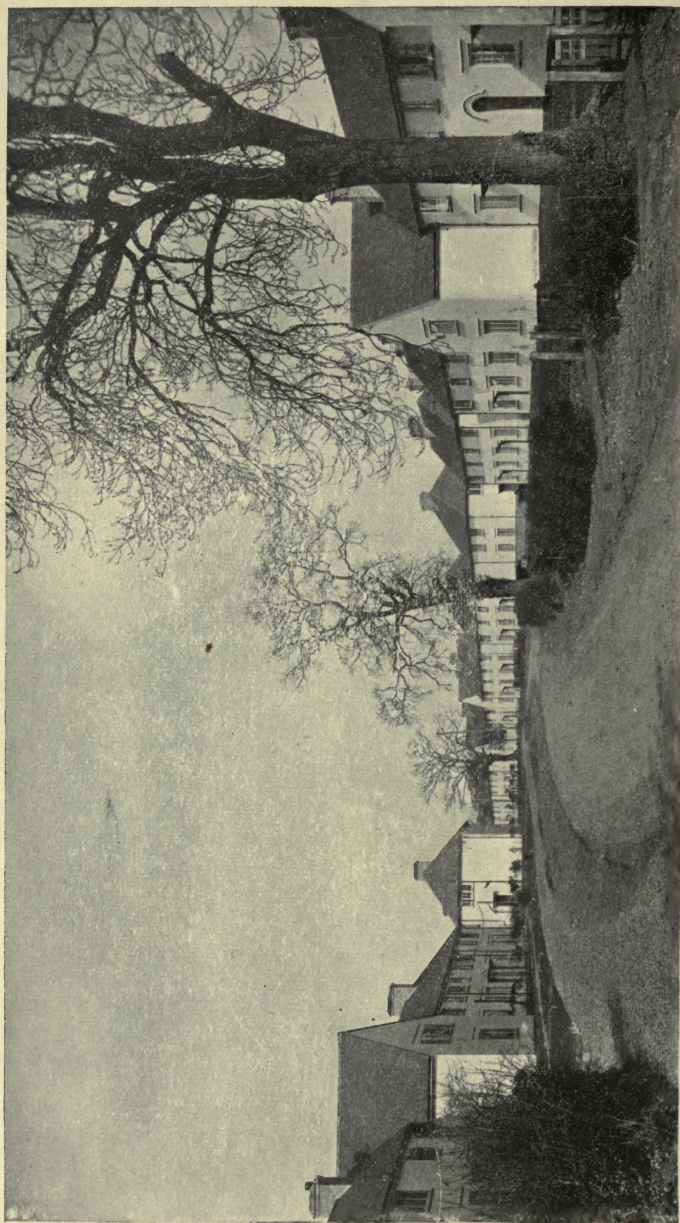
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SITE PLANNING IN PRACTICE



HANDSIDE LANE, WELWYN GARDEN CITY.

Frontispiece.]

OXFORD TECHNICAL PUBLICATIONS

SITE PLANNING IN PRACTICE

AN INVESTIGATION OF THE PRINCIPLES
OF HOUSING ESTATE DEVELOPMENT

BY

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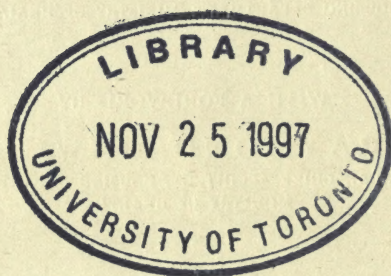
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TO
MY MOTHER

FOREWORD

THE conviction has been growing during recent decades that more care than has hitherto been considered necessary should be taken to secure the proper use of land, and that greater skill should be devoted to the laying out of building estates and to the orderly development of towns. It is now realised that the best results are not obtained by submitting tamely to the vagaries of haphazard growth, but can only be secured by the exercise of foresight in the distribution of the parts of a town, and in the considered arrangement of the roads, buildings, and open spaces upon each site. But, both in the larger sphere of *town* planning and in the more detailed branch of the work which is concerned with the laying out of residential areas and which may for convenience be termed *site* planning, there is ample need for further study of the conditions and possibilities. Hence Mr. Longstreth Thompson has performed a valuable service in compiling a volume in which reliable information, considered principles, and established practice are assembled and co-ordinated by one who is well qualified by training and experience to select from the large amount of material available that which should be included, and to reject much which is still too tentative or experimental for the purpose in view.

In addition to dealing with the more usual branches of the subject, Mr. Thompson has pursued several original lines of inquiry. There are, for example, some interesting statistics as to the various types of business, public, or semi-public buildings normally associated with a given population, which should prove a valuable guide in estimating

the provision that has to be made for these purposes in the development of new residential areas. And there is an instructive analysis of the effect of different densities of development on the most convenient and economical shapes and sizes into which land can be subdivided by the roads.

Mr. Thompson, in his book, shows how experience has proved the essential economy of open development. The percentage of the total population for which this method provides the most suitable residential surroundings has yet to be determined. It seems clear, however, that the limit in this direction has not yet been approached, and that, meantime, both economy and other considerations of social welfare suggest the importance of providing every new house with sufficient ground for the cultivation of a small garden.

In spite of the fact that there may be found many good examples of comprehensive site planning carried out in the past, we must admit that, generally speaking, the building development of the last century reflects no great credit either on the intelligence of land owners, or the skill of their technical advisers. Frequently the development has not even had the merit of being economical, and where it has been economical in a certain sense, too often advantages of an outstanding character and amenities of permanent value have been entirely sacrificed to secure a quite minor and temporary monetary advantage. The importance of devoting care and skill to the laying out of all lands which are to be used for human occupation cannot easily be exaggerated, especially in view of the permanence of the conditions which are thereby established, and it is to be hoped that Mr. Thompson's book will contribute to the realisation of the character and importance of this work, as well as help to improve the general standard of practice in connection with it.

RAYMOND UNWIN.

INTRODUCTION

THE subject of Housing has been approached from many different angles. Contributions to the common store of knowledge have been made from time to time by Sociologists, Hygienists, Architects, Landlords, Lawyers, and Politicians, concerning those aspects of the problem with which they are most closely in touch. It might seem, therefore, that but little scope remained for the breaking of fresh ground. But, although the field is already so well cultivated, there is still one corner of it that has not yet received intensive treatment. In this country, at least, no detailed study of Housing development as an integral part of Town Planning has hitherto been attempted, and it is in the hope of doing something towards filling this important gap in the literature of the subject that the present volume has been written.

While it cannot be claimed that the newly awakened art of Civic Design has reached its full development, it must be admitted that considerable progress has been made in that department of it which is concerned with the planning of residential areas. A quarter of a century has elapsed since Mr. Ebenezer Howard advanced what were then regarded as his Utopian proposals for the establishment of Garden Cities, and it is many years since Mr. Raymond Unwin, among his many contributions towards the concrete realisation of better standards of housing, demonstrated the economic fallacy of "overcrowding." During this period much has been learned of the practical application of these once revolutionary ideas. The experience gained through the earlier experiments, of which Port Sunlight, Bournville, New Earswick, Woodlands,

Letchworth, and Hampstead Garden Suburb are typical examples, has been augmented by that derived from the host of smaller enterprises undertaken by Public Utility Societies all over the country. In addition, the immense programme of the National Housing Scheme, initiated by the Government to make good the shortage of houses occasioned by the War, has provided an unparalleled opportunity for testing upon a large scale the value of many theories of Site Planning, not hitherto supported by evidence of a sufficiently extensive character to be altogether reliable. Thus, a large amount of valuable information concerning the technical problems of development has already accumulated, and it would seem to be, therefore, a particularly suitable occasion for an attempt to deduce from the experience now available such principles as may be found to have general application to the development of residential areas.

Unlike the majority of subjects upon which technical treatises are written, Housing cannot readily be isolated from its natural surroundings and subjected to a purely scientific analysis. The human element is so essentially part of its very structure that, even in a work primarily devoted to the technical aspects of the problem, it is impossible to avoid frequent reference to the philosophical and sociological questions which arise at almost every stage of the argument. For it must be recognised that theories of housing or town planning which are based upon no surer foundation than mere technical efficiency have but little chance of permanent success. If any proof were needed of this statement, it is supplied by the poorer residential districts of every modern town, where, in the absence of any civic ideal beyond that of an admittedly high standard of sanitary efficiency, there have grown up vast districts, "which," as Mr. Unwin has observed, "for dreariness and sheer ugliness it is difficult to match anywhere, and compared with which many of the old unhealthy slums are,

from the point of view of picturesqueness and beauty, infinitely more attractive." "The truth is," to continue the quotation, "that in this work we have neglected the amenities of life. We have forgotten that endless rows of brick boxes, looking out upon dreary streets and squalid backyards, are not really homes for people, and can never become such, however complete may be the drainage system, however pure the water supply, or however detailed the by-laws under which they are built. Important as all these provisions for man's material needs and sanitary existence are, they do not suffice." A wider vision is needed, in which houses are regarded as homes, and homes as part of that social entity which we call the town. The business of the town-planner is to guide and interpret, as far as he is able within the limits imposed by practical considerations, the civic needs and aspirations of those for whose material comfort and convenience he has to provide.

If this view of the matter is accepted, and there are unmistakable signs that it is coming to be regarded as the only reasonable attitude to adopt, it follows that all housing proposals must form part of a comprehensive policy of town development. Thus the investigation of the general tendencies of urban growth, and the detailed survey of the particular town or region in question, which are outlined in the first two chapters, will be recognised as preliminary studies essential to the due consideration of the problems connected with the choice and development of housing estates. For without a knowledge of the existing conditions and probable future growth of a town it is impossible to arrive at a clear decision as to the best means of making adequate provision for the accommodation of its steadily increasing population.

It will be observed that the methods of development examined in the following pages are based upon a building density of twelve houses to the acre. This figure is now so generally accepted as a reasonable standard, that its

adoption here requires no justification. But while no single factor has had so great an influence upon the *details* of Site Planning as this limitation of density, and valuable as are the results thereby achieved, it must not be assumed that the employment of a system of open development is the sole desideratum in the laying out of residential areas, for it is necessary to consider not merely the comfort and convenience of the individual, but also the general needs of the community. Hence the primary conditions which must be satisfied by the plan are, that its main outlines should fit in with the projected development of the town considered as a whole ; that adequate localisation of interest should be secured by the creation of a centre where the social life of the district would find a natural focus ; and that due provision should be made for the open spaces, public buildings, shops and other similar requirements of the future residents. These conditions can and, indeed, must be fulfilled irrespective of the building density, which, although a vital consideration from the point of view of health and amenity, is, so far as the development plan is concerned, a determining factor only in the arrangement of the minor roads. In this matter, however, the reduction of the density to an average of twelve houses to the acre has revolutionised the methods formerly in use. The greater freedom in road location and design, which is permitted by the increase in the size of the house plots, has resulted in the abandonment of the stereotyped system of parallel streets and in the adoption of the much more rational procedure of adapting the lay-out plan to the contours of the site. By this means not only is it possible to preserve and even enhance the natural beauty of the estate (for, as Dean Inge has observed, " We sometimes forget that until the reign of George III. a town was regarded as improving a landscape "), but also to effect considerable economies in the actual cost of development. Thus the criticism, frequently made at one time, that a reduced

density involved increased expense, is rendered invalid where the price of land is reasonable and care is exercised in preparing the plan. While if value received for money spent is a sound criterion, there can be no question of the economy of a system which secures to each householder all the advantages of a garden for the same expenditure as would previously have been necessary to provide a mere backyard.

The full advantages of such a system, however, cannot be achieved under the regulations hitherto enforced in regard to the construction of roads and sewers in the majority of our towns. These were designed to protect the citizens from the worst features of a type of development which, under a proper system of town planning control, can never be resuscitated. There is reason to hope, therefore, that at no distant date the modifications which have already been sanctioned by the Ministry of Health in connection with the Government Housing Scheme, and have stood the test of experience, will be incorporated in the by-laws of every municipality in the country.

In bringing these introductory remarks to a conclusion, I wish to express my gratitude to those whose kind permission for the reproduction of plans and photographs has made it possible to include among the illustrations representative examples of modern practice in the development of Housing Sites. My thanks, also, are due to Mr. Raymond Unwin, Mr. Thomas Adams, Mr. Eric Hayman, and Mr. A. Trystan Edwards, whose advice and criticism have been invaluable. Lastly, I must record my appreciation of the help and encouragement of my mother and my wife, whose labours in connection with the manuscript and diagrams have been of the greatest assistance in the preparation of the book.

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LONDON, S.W. 1.

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SITE PLANNING IN PRACTICE

CHAPTER I

HOUSING POLICY AND URBAN DEVELOPMENT

Housing a Function of Town Planning.—The unprecedented shortage of houses with which this country was faced at the termination of the War, brought into prominence many aspects of urban development which had not previously received adequate consideration. Of these, the problem of dealing satisfactorily with the continual expansion of our large cities is one of the most important. Under normal conditions the process of extension had been so gradual and the agencies through which it had been effected so numerous, that it was difficult to realise how rapid this growth had become or to what unwieldy proportions some of our towns had attained. But the magnitude of the accumulated deficiency resulting from the almost complete cessation of building for a period of nearly five years, and the necessity for making good this shortage *en masse*, made apparent the desirability of pausing to consider whether the addition of large numbers of houses to already overgrown towns was the most advantageous method of providing the required accommodation. It was thus realised that a comprehensive scheme of urban development is the necessary basis of a satisfactory housing policy, and that the initial step in the formulation of the latter is to arrive, in each case, at a clear and reasoned conclusion as to whether it is better to enlarge the

residential district of the existing town or to create a separate and self-contained unit. This decision, while it is of fundamental importance to the preparation of the housing scheme and influences every operation from the choosing of the site to the disposition of the buildings, has a further and far greater significance. It involves the adoption of a definite policy with regard to one of the most crucial problems of urban development, namely, what is the desirable size of a town, and how far is it practicable to secure it?

Towns of Excessive Size undesirable.—There is little doubt that in many of our large towns the economic and social advantages derived from the concentration of population at an urban centre are to some extent neutralised by the great expense of providing the necessary public services, the lack of space for industrial expansion, and the absence of that organic relationship between individuals and the community which is one of the best features of town life. What Cobbett described as the "Great Wen" of London is, perhaps, the most striking illustration of the undesirable results to which uncontrolled expansion leads. Every one is familiar with the inconvenience and loss of time incurred in the daily journey to and from work by reason of the congested state of the traffic in the metropolis. But few realise what this loss of time means in terms of money. It is difficult to make an estimate with any approach to accuracy, but even upon a basis of computation which is manifestly an understatement of the facts the result is somewhat startling. Assuming, for example, that only one-tenth of the population of Greater London, or 750,000 people, waste each day in travelling one hour more than they would in a town of moderate size, and that the average value of their time is only 1s. per hour, the aggregate loss is £37,500 a day, or £11,250,000 in a year of 300 working days.

The effect upon industry is less obvious, but the gradual

HOUSING POLICY AND URBAN DEVELOPMENT 3

exodus of manufacturing concerns to new centres outside the metropolitan area shows that the high rates, excessive cost of land, and lack of room for expansion, which result from over-concentration, have outweighed the advantages to be derived from a central position.

Of a somewhat different character is the lamentable lack of interest in local government and local affairs generally which has resulted from the assimilation of towns and villages by the Great City. As William J. Locke has said in *The Fortunate Youth*: "A London borough, unlike a country town, has very little corporate life of its own. You cannot get up as much enthusiasm for Kilburn, say, as a social or historical entity, as you can for Winchester or Canterbury. You may perform civic duties, if you are public-spirited enough, with business-like zeal, and if you are a borough councillor you may be proud of the nice new public baths which you have been instrumental in presenting to the community. But the ordinary man in the street no more cares for Kilburn than he does for Highgate. He would move from one to the other without a pang. For neither's glory would he shed a drop of his blood. Only at election times does it occur to him that he is one of a special brotherhood, isolated from the rest of London; and even then he regards the constituency as a convention defining geographical limits for the momentary range of his political passions."

Many other ill effects of excessive size, such as the virtual separation of the dwellers in the central districts from the regenerating influence of the open country and the mental stultification produced by living in the mean surroundings of dreary suburbs, will occur to the reader.

Circumstances determining most Effective Size.—All this goes to show that towns can grow too big, and that there is a point of maximum efficiency beyond which mere increase of size operates adversely. At what stage of development this limit is reached is a matter requiring

much closer investigation than it has hitherto received ; it is quite obvious, however, that there is no " one best size " applicable to all cases. The variety of interest and occupation necessary to the full enjoyment of social intercourse, for example, will not be secured in a town, depending principally upon one industry, at the same limit of population that would be adequate in a town possessing varied industries. Regarded from the standpoint of health, also, it may happen, as in the narrow Welsh valleys, that the land adjacent to a town is unsuitable for housing purposes, and this fact will exert a limiting influence entirely absent from the majority of cases. Again, from the economic point of view the variation in conditions at different places often determines what is the best size for efficiency. Thus the cost per head of water supply would be a restricting factor in the case of a town which was approaching the limit of its local supplies, and which could only increase its consumption by tapping a distant source at great expense. In a similar way the difficulty of sewage disposal might set a limit to the size of a town situated on flat, low-lying land at some distance from the sea, as, for example, in the Doncaster area, while it would not affect a seaboard town at all.

Arbitrary Limitation Useless.—But, apart from physical factors, the growth of towns is so much a matter of human psychology that no arbitrary limitation of their size can have the least chance of success. Hence, before coming to any conclusion in the matter, it is necessary to study carefully not only the circumstances of any particular place, but the general tendencies of urban growth.

Industry the Predominating Factor in Urban Growth.—In spite of all their drawbacks, the big towns continue to grow. There is a fascination about them which is almost irresistible. The lure of the crowd, the opportunities for a successful career, facilities for higher education and culture, and cheap amusements, all contribute to their

popularity and cause them to expand. But if one has to pick out the most vital factor in urban development, the choice must inevitably fall upon industry. For without industry no modern town could either come into being or continue to exist. So that in considering the probable future growth of any town with a view to a satisfactory solution of its housing needs, our attention must be directed principally towards the conditions which affect industrial development.

Industrial success depends upon many factors, some of which, such as efficient and progressive management and skilful advertisement, are outside the purview of the Town Planner. But two, at least, of these factors come within his province and must be considered in relation to the future growth of the town for whose needs he has to provide. In the first place, there is the advantage which accrues to an industry by its being placed in a locality where the conditions are suited to its particular requirements; and, secondly, the necessity for a situation in proximity to an adequate supply of labour. Both circumstances tend towards a concentration of industry and consequently of population.

Industrial Centralisation. — *Physical Causes.* — The possession by certain localities of peculiar natural advantages is one of the most fundamental causes of industrial centralisation. Mines, for instance, must obviously be situated upon the geological formations which yield their raw material. A plentiful supply of soft water is so important to the processes of brewing and of textile printing, that the possession of this natural advantage places Burton and Dublin in one respect, and Glasgow and Lancashire in the other, in an unassailable position. The influence of climatic conditions is nowhere better illustrated than in the case of the valleys of South Lancashire and the West Riding of Yorkshire, where the humid atmosphere created by the impact of the Gulf Stream and the Arctic current

in the Irish Sea is so exactly suited to the requirements of the textile trades that this region holds the textile supremacy of the world; while the very obvious need of a sheltered harbour or navigable estuary for the establishment of a seaport is another instance of the influence of physical factors in the location of industries and the growth of towns.

Inter-dependence of Industries.—Closely connected with the centralising tendency produced by natural conditions, is the mutual advantage which is derived from the proximity of main and subsidiary industries. This is particularly evident in the economy of time and expense in the transport of goods which have to undergo several specialised processes in the course of their manufacture. Where the requirements of the main industry limit the range of possible locations to a comparatively small area, there follows the concentration not only of similar industries, but of all subsidiary industries as well. The result is the formation of those vast 'Con-urbations' to which Professor Geddes has given such names as "Lancaston," "Midlandton," and "Clyde-Forth."

Transport Facilities.—Another consideration of great importance in the location of a factory is the desirability of securing a site which not only has the advantage of convenient access to a suitable means of transport, but which is also well situated in regard to the principal lines of communication. The nature of the raw materials and the finished products, and their origin and destination respectively, will determine for each trade whether proximity to a railway centre, a port, or the focal point of a system of main highways, affords the most strategic position. But whatever the requirements in this direction may be in any particular case, adequate facilities for receiving and distributing goods in an economical manner are essential, and in so far as they are available in a comparatively limited number of places they must be regarded as a material factor in industrial concentration.

The Supply of Labour.—The fourth great cause of the grouping of industries is the necessity for labour to migrate to localities where there is a variety of employment for all members of the family. The influences here operating are to a large extent reciprocal, the workers flock to the industrial centre, while the manufacturer is attracted to the place where labour is already plentiful.

Industrial Decentralisation.—*Causes.*—But there is a limit to the advantages secured by centralisation, and where this has been reached it has given rise to a marked tendency towards decentralisation. It has been found, for example, that, if the industrial area grows very large, the competition for sites is so keen that the cost of land becomes altogether excessive, the space available for expansion is insufficient, and adequate access to transport facilities is rendered impossible. Residential districts also become too far removed from works centres, and the cost of administering the city is so great that the rates become a heavy burden on industrial enterprise. The negative disadvantages of over-concentration are furthermore reinforced by the positive advantages of decentralisation of which the development of motor transport and the cheap distribution of electrical power, or, alternately, the economical generation of power by small self-contained units, may be cited. There is also the growing demand amongst all classes of the population for the possession of a garden and some of the amenities which are not usually associated with life in large cities.

Tendency to form new Industrial Centres.—There are, in fact, two forms of decentralisation in progress: decentralisation of industry and decentralisation of population. Both are regulated by the advantages of a certain measure of concentration and by the necessity for reasonable transport facilities. In the case of industry, the earlier experiments in decentralisation, which led individual manufacturers to remove their works from congested

centres and plant them in isolated positions in the country, were in many cases so disastrous that the disadvantages of isolation were amply demonstrated. At the present time the tendency is for industries to break away from the cramped conditions of the large towns and regroup themselves in new centres, where it is possible to secure better conditions both for workers and works. This movement is, relatively speaking, still in its infancy, but it promises to be one of the most important factors in the future development of towns.

Housing Policy.—Examined in the light of these general tendencies, the results of the Regional or Civic Survey, described in the next chapter, will indicate the policy which it will be advisable to adopt in any particular case. The ascertained need for houses and its distribution, the present size of the town and the desirability of increasing it or of creating some fresh centre and the forecast of future development will be the deciding factors.

Addition to existing Town.—Where a town is not too large and where no decentralising tendency is apparent, the Housing Scheme should in most cases take the form of an addition to the town, almost entirely residential in character, and for that reason not too great in extent. It is generally much better to have several smaller areas with sufficient definition of boundary to preserve local identity and local interest than to concentrate upon vast schemes of almost unavoidable monotony.

Dormitory Towns.—In circumstances which render the placing of houses close to the centres of industry undesirable, as, for example, in the case of coal mining (where the liability to subsidence or the topographical conditions make the land unsuitable for residential areas), the method suggested by the South Wales Regional Committee of establishing Dormitory Towns is well worth considering. Such towns would possess their own shops and what may be described as their domestic industries, such as bakeries,

laundries, building, wood-working, and so forth, in addition to their own educational and recreational facilities, but would be dependent upon the industrial centre to provide the principal occupation of their inhabitants. They would, in fact, partake very much of the character of the majority of present-day suburbs, except that they would be properly planned and defined by means of a permanent agricultural belt. But in so far as the interest of the inhabitants would be divided between the place of work and the place of residence, the dormitory town would be apt to suffer from the same lack of local civic enthusiasm which is now so deplorable a feature of suburban life.

Satellite Towns.—As a method of surmounting this difficulty the principle of Satellite Towns has very much to recommend it. Such towns would be in a large measure self-contained, and would possess their own industries, which would be subsidiary and complementary to the major industries of the parent city; they would, while maintaining a close association with the source of their being, preserve their own individuality. In this way, many of the difficulties inherent in the over-concentration of population would be avoided and at the same time the benefits derived from association would not be lost. This principle is peculiarly applicable to such places as Liverpool, Manchester, Leeds, and many others where the major industries are immovably fixed by physical requirements, but where further enlargement of the built-up area is highly undesirable. There can be little doubt, indeed, that the establishment of Satellite Towns is destined to be the generally accepted policy of urban development in the future.

Garden Cities.—The Garden City, of which we have examples at Letchworth in a fairly advanced, and at Welwyn in an embryonic stage, is perhaps the ideal form of the satellite town. It is defined to be “a town planned for industry and healthy living; of a size that makes possible

a full measure of social life, but not larger. Surrounded by a permanent belt of rural land, the whole of the land being in public ownership or held in trust for the community." Though this is the definition of an ideal, it is not the description of a Utopia, as the practical experiments at Letchworth and Welwyn are now proving. It does not, moreover, apply merely to the establishment of new towns, although its realisation is more easily achieved in that way ; it represents the goal towards which should be directed the efforts of those who are concerned with the gradual improvement of their town, whether in connection with housing or in other ways.

Whatever may be the circumstances of the particular case, two main objects should be kept in view ; the convenient distribution of the parts of the town and the adequate localisation of the life of its citizens. The extent to which it is possible to ensure the attainment of these fundamental conditions by the adoption of one or other of the systems of urban development which have been described will be the principal factor in determining the character of the Housing Policy.

CHAPTER II

THE PRELIMINARY SURVEY

WHILE many of the problems of civic design give rise to opposing schools of thought, there is one proposition which would receive the immediate assent of all town planners, namely, that any considerable addition to, or modification of, a town plan should be preceded by a survey of the economic, industrial, and sociological conditions.

Extent of Survey necessary for Housing Purposes.—

The extent of these preliminary investigations will naturally vary with the circumstances of the individual case. In many instances, such as villages and small towns situated in a purely agricultural area, the provision of additional housing accommodation is a simple matter for which an elaborate survey is quite unnecessary. In other cases, where more or less isolated towns are expanding as the result of growing industries, popularity as health resorts or for other reasons inherent in the town rather than in the locality, a careful survey of the needs of the town itself will serve the purpose at present under discussion. But there is a third category which comprises towns whose development is subject to economic conditions that determine the industrial growth of whole districts. Typical examples are to be found in the coalescing groups of towns which, on account of natural strategic advantages, have grown up around a common industry and which are a characteristic feature of the Midlands, of Lancashire, Yorkshire, Northumberland and Durham, and of the Clyde and Forth ; closely allied to these is the vast agglomeration of

Greater London. In such cases nothing short of a Regional Survey will furnish sufficient data for the forecast of the future needs of the district, which must precede the formulation of all housing proposals.

REGIONAL SURVEYS

Subjects of Investigation.—An excellent example of the kind of survey which it is desirable to make, is to be found in the Report of the South Wales Regional Planning Committee. This Committee was appointed “to enquire and report upon the special circumstances affecting the distribution and location of the houses to be erected with State Aid in the region of the coal-fields of South Wales, and to make recommendations thereon, regard being had :

- “ (a) to the health and convenience of the industrial population ;
- “ (b) to the physical conditions of the region ;
- “ (c) to the present and probable future development and location of the coal mines and main industries of the region ;
- “ (d) to the existing and necessary transit facilities ;
- “ (e) to economy in the provision of water supply, sewerage, and other services.”

Although these terms of reference clearly do not cover all the points which should be included in a complete Regional Survey, they are sufficiently wide to ensure a thorough examination of the more important aspects of the housing problem in a region possessing peculiar difficulties. The Report, which, for reasons of economy, has been published in an abridged form, presents the results of an inquiry into, amongst others, the following matters which all bear more or less directly upon the subject at present under consideration.

A. PHYSICAL CONDITIONS.

1. Area covered by the survey.
2. Geology.
3. Physical features.
4. Climate.

B. INDUSTRIES.

C. POPULATION.

1. Growth and distribution.
2. Occupation.
3. Character.

D. HOUSING CONDITIONS AND NEEDS.

1. General Standards of Accommodation.
2. Slum areas.
3. Scarcity of dwellings.
4. Housing agencies of the past.
5. Present programme of local authorities.

E. FUTURE INDUSTRIAL DEVELOPMENT AND HOUSING NEEDS.

1. Probable future development.
2. Factors influencing future development.
3. Tendency towards industrial combination.
4. Effects of higher leaving age in schools.
5. Effects of reduced working hours.
6. Industrial prospects in particular areas, and their relation to housing.

F. PROVISION OF HOUSING ACCOMMODATION.

1. Unsuitability of certain sites.
2. Areas available for future housing,
 - (a) within the coal-field ;
 - (b) outside the coal-field.
3. Distance of housing centres from industries.

4. Grouped housing areas ; advantages and disadvantages.
5. Dormitory towns.

G. LOCAL GOVERNMENT ARRANGEMENTS.

H. ENGINEERING SERVICES.

1. Sewerage.
2. Water Supply.
3. Electricity.
4. Gas.

I. COMMUNICATIONS.

1. Roads.
2. Canals.
3. Railways.
4. Seaports.

J. TRANSPORT FACILITIES.

1. Existing.
2. Suggested improvements.

K. PITHEAD AND FACTORY BATHS

L. RECREATION.

1. The demand.
2. Provision of space for recreation.
3. Utilisation of waste land.
4. Acquisition of mansions and park lands.
5. Holiday and health centres.
6. Indoor recreational and educational facilities.

M. IMPROVED AMENITIES.

1. Demand for improved surroundings.
2. Colliery tips.
3. Coal dust and smoke nuisance.
4. River pollution.
5. Domestic coal supplies.
6. Planting of hillsides.

N. REGIONAL TOWN PLANNING.

1. Need for town planning.
2. Need for regional town planning.
3. Joint Town Planning Committees.
4. Regional Town Planning Board.

O. NEED FOR A NEW LOCAL GOVERNMENT AUTHORITY
IN THE FORM OF A REGIONAL COUNCIL.

The principal Conclusions and Recommendations are summarised in a convenient form at the end.

This is not a complete table of contents of the Report, as certain of the subjects of inquiry which relate to conditions peculiar to South Wales have been omitted in order to present the material in a form suitable for general application. But, formidable though the list may appear, its scope does not extend beyond the limits of those matters which directly affect the proper development of the region and therefore the proper location of its residential areas. In order to appreciate the value of such a survey as a preliminary step to the formulation of housing proposals, it is worth while to examine the conclusions arrived at as the result of this particular inquiry.

Lessons from the South Wales Survey.—*The Effect of Physical Conditions.*—In South Wales the most important factor in the development of the whole region is, of course, the presence of the coal measures. At least one-third of the male population is employed in the coal-mining industry, and in many districts this is the sole industry of importance. It follows, therefore, that the geological formation of the coal-fields and the physical characteristics related thereto are the preponderating influences in the distribution of the population. The coal-field occupies an area of about 800 square miles, and is bounded on the south by the Coastal Plain (280 sq. miles) and the Peninsula of Gower (58 sq. miles). It lies for the most part beneath

the Pennant Plateau, which has a general altitude of 1000 feet above sea-level and is intersected by narrow steep-sided valleys. In these valleys, hemmed in on either side by high mountains, the mining industry and the mining population are concentrated. There are virtually no really suitable housing sites on account of the narrowness of the valleys, the steepness of the hillsides, the liability of the land to subsidence, and the extent of the land occupied by colliery works, railways, canals, and roads. Nevertheless, in spite of all these unfavourable conditions, circumstances have compelled the miners to live close to their means of livelihood, so that houses have been built and towns have arisen which for sheer dreariness and gloom are probably unsurpassed in any other part of the United Kingdom, possibly of the world.

The Trend of Industrial Development.—These, then, are the conditions under which the bulk of the population is living at the present time. In considering the steps which should be taken to meet further housing needs, the Committee had first to review the direction which industrial development was likely to take. The evidence before them indicated that although it was not to be anticipated that there would be any considerable number of new collieries opened, the facts pointed to the extension of existing collieries. Moreover, a higher school-leaving age and a shorter working day were likely to result in the employment of increased numbers of men and consequently in an increased demand for houses.

Housing Areas available.—The need, and the localities in which it was likely to arise, being thus established, it next became necessary to decide upon a general policy for dealing with the situation. It had already been agreed that the valleys in which the existing development had taken place were in most cases unsuitable for building houses, and there remained, therefore, two alternatives—either, adhering to the practice of providing accommodation

locally, to build on the tops of the hills, or else, adopting an entirely new principle, to place the houses in the open country and away from the coal measures altogether.

Comparison of Alternative Sites.—The hilltop areas, although in some cases the actual or projected sites of large housing schemes, are not generally suitable for this purpose. Difficulty of access, absence of water supplies, the exposed situation, poverty of soil, and the liability of subsidence are all factors which render these areas undesirable, and the Committee were strongly of opinion that sites either in the valleys or on the hilltops should only be utilised when the conditions were exceedingly favourable, or the positions or character of the industries were such that it would be very inconvenient if the workmen were to reside at a considerable distance from the works.

There are many advantages to be gained by grouping housing schemes outside the valleys and away from the coal measures. Considerable areas of excellent building land are available, and the cost of sites, estate development, and building should be considerably below that now obtaining in the narrower valleys. By concentrating labour and material at comparatively few centres, also, it should be possible to organise the work better and consequently to build more expeditiously and more cheaply than when building activities are distributed over a large number of sites. Such a scheme of grouping would enable new townships to be created with adequate provision for educational, recreational, and social institutions of all kinds; the organisation of transport and other services would also be facilitated thereby.

The principal objection to this method of dealing with the problem is that it would necessitate a considerable amount of daily travelling on the part of a large proportion of the miners. But after carefully weighing the evidence on both sides, the Committee came to the conclusion that

the majority of miners would be prepared to put up with the inconvenience of travelling, in order that they and their families might have the advantage of a healthier and more attractive environment for their homes.

Determination of Future Policy.—In view of these considerations the Committee recommended that the future housing policy of the area under their investigation should be to abandon, as far as possible, the idea of providing small groups of houses in scattered positions where it is impossible to secure an environment conducive to a high standard of social life and personal efficiency, and to concentrate on the provision of housing accommodation in a few selected centres outside the valleys and off the coal measures. To quote from the Report: "Owing to the small areas of local authorities and the parochial outlook of some of their members, the problem of housing in South Wales has hitherto been considered from too narrow a standpoint, and greater consideration has been paid to personal interests and to local sentiment than to the welfare of the community as a whole. We feel that the policy of scattering houses over a number of small sites within comparatively short distances of one another is a mistaken one and should be discouraged in the case of future housing schemes. We are of opinion that the concentration of housing schemes on a few large areas, on which new townships could be established or existing townships considerably extended, would in the long run be preferable, not only from the social point of view, but also with regard to the cost of construction and administration, and we are satisfied that, given proper transport facilities, such townships would meet the convenience of the people whose needs are to be catered for."

Practical Recommendations.—Fifteen centres are suggested at which large schemes capable of serving the needs of the different districts of the region could advantageously be carried out. Practically all these centres are in the

vicinity of railway junctions and are served by more than one line of railway, and in most cases the water supply, sewerage, and other services are already available or can be provided without much difficulty. It is the opinion of the Committee that each of these settlements should partake of the nature of a dormitory town some distance away from the industrial centres, almost entirely residential in character and of a size definitely limited by a permanent agricultural belt within the boundaries of its own jurisdiction. Another feature upon which stress is laid is that the residents should belong to different industries in order to counteract the bad effects resulting from sameness of occupation, which, it is held, contribute in no small degree to the prevalent state of industrial unrest. The Committee recognised that their proposals took a somewhat novel form, and in view of the difficulties which may be anticipated—particularly from the local government point of view—they held it to be very desirable that examples of dormitory towns should be established, as object lessons, by the Government forthwith.

Ancillary Measures.—The remainder of the Report deals with practical matters such as Engineering Services, Communications, Transport Facilities, and Local Government arrangements, the modification and improvement of which are considered to be necessary to the proper execution of the housing policy. And lastly, emphasis is given to the need for regional planning in dealing with the development problems which are encountered in this area. Although a comparatively small section of the Report is devoted specifically to this subject, it forms the basis of the entire investigation and underlies the whole of the Committee's recommendations. The concluding paragraphs are, in fact, a summary of the argument for comprehensive treatment, with suggestions as to the means by which the requisite amount of co-operation and unified control can be secured.

The Practical Value of the Survey.—Considerable space

has been devoted to this Report for two reasons—in the first place, because the nature and extent of the investigation provide an excellent model for the preliminary survey which should precede the formulation of housing schemes ; and in the second place, because the conclusions arrived at are a striking illustration of the value of such a survey, and may help to dispel the too prevalent idea that inquiries of this kind, while they may be of great academic interest, are not of sufficient practical utility to justify the labour and expense which they entail. That such a view is mistaken is abundantly proved by the results of the survey in question. For the existing conditions—admitted by every one to be highly unsatisfactory—are carefully analysed and shown to be the result, not only of bad local planning, but of the limited and parochial outlook which has characterised the housing policy of the past. So that instead of urging the merely palliative measure of adopting better housing standards in each locality, the Committee recommended a bold policy of grouped schemes, based upon regional needs, as the only satisfactory solution of the difficult problems which have to be faced in South Wales. That such a conclusion, involving, as it does, a complete departure from the generally accepted principles of localised action, should have been arrived at as a result of a detailed examination of the conditions by a Committee of technical experts and practical business men, is indisputable evidence of the value of the work undertaken.

Other regions in an analogous position have appreciated the desirability of co-ordinated action, and it is encouraging to note that at the present time similar investigations are in progress in connection with the South Yorkshire coal-field, West Middlesex, the Manchester District, and Tees-side. It is, one hopes, now only a matter of time before such surveys are undertaken in all areas where identity of interest or close grouping of urban centres render co-ordinated action essential.

TOWN SURVEYS

We have, so far, considered briefly the necessity, in

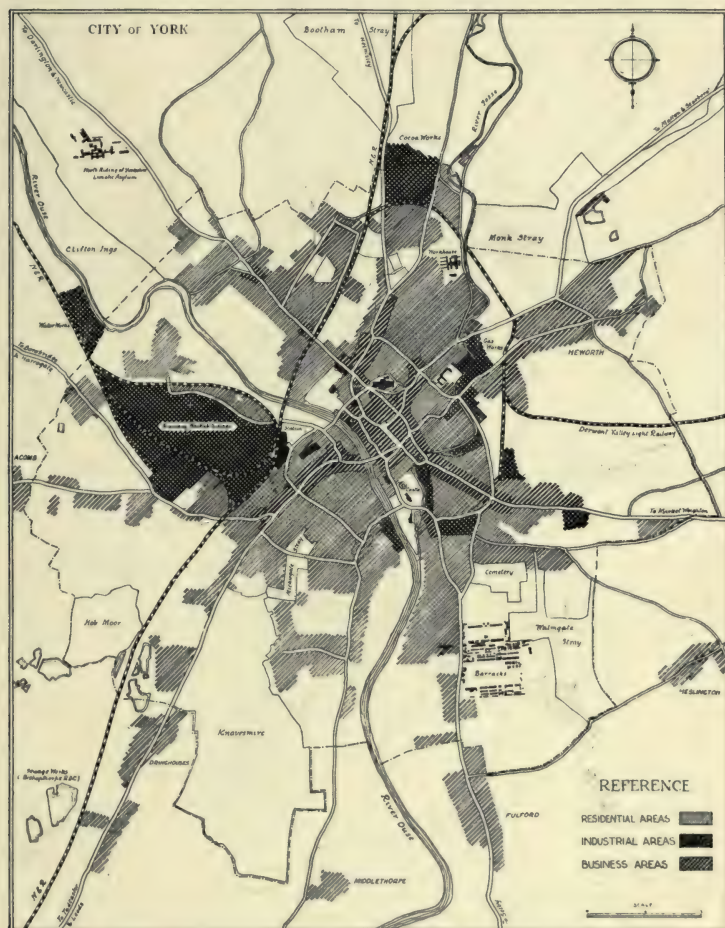


FIG. 1.—City of York : Diagram showing distribution of different kinds of buildings.

certain circumstances, of making a regional survey in order to obtain sufficient data for the formulation of such

so far as housing is concerned, the development of the individual town is the principal consideration. In such

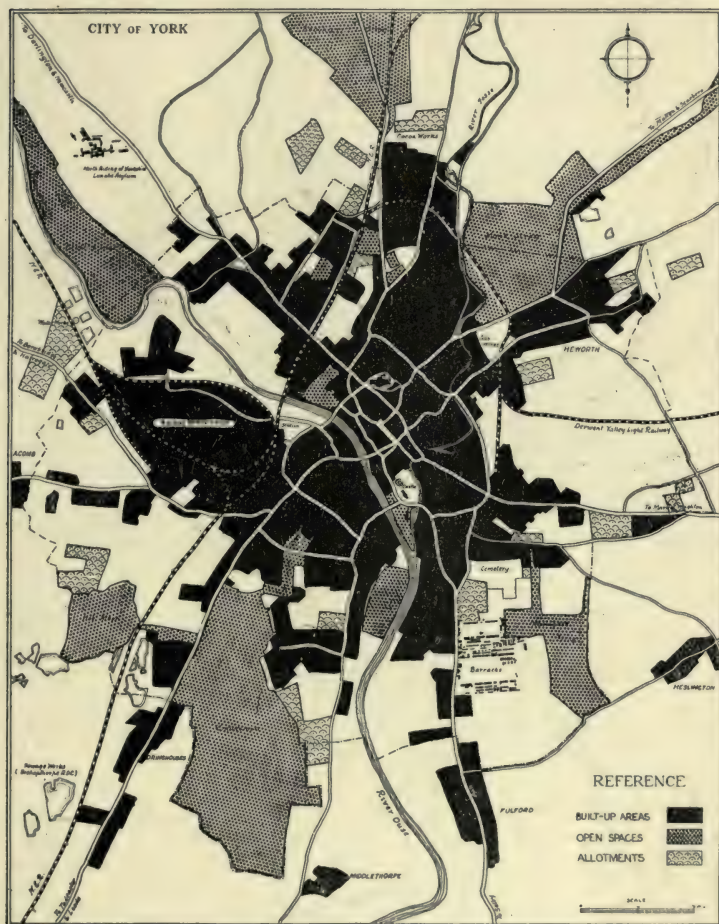


FIG. 3.—City of York : Diagram showing distribution of Open Spaces and Allotments.

cases, the preliminary survey may be confined to the town and its immediate environs.

Scope of Inquiry.—The range of subjects which it is

desirable to investigate will not differ greatly from that outlined for the Regional Survey, indeed, the principal

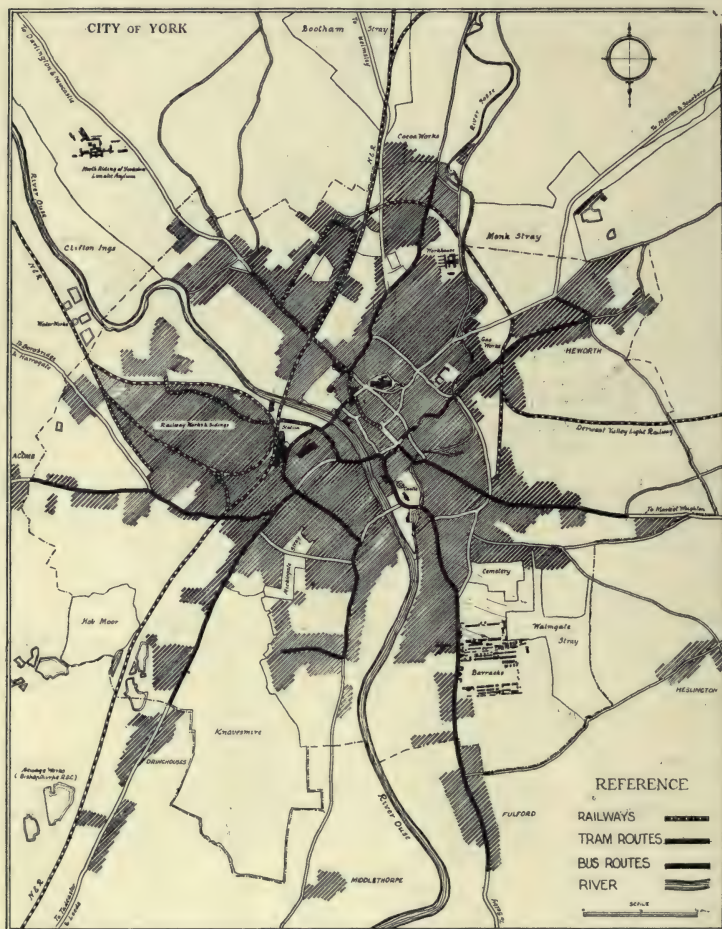


FIG. 4.—City of York : Diagram showing existing means of communication.

headings might be the same. It is not suggested, of course, that these headings cover the ground of a complete regional or city survey, which will naturally be of wider scope and

will include matters not germane to our immediate inquiry. But, for practical purposes, a study of the conditions in-



FIG. 5.—City of York : Time-Zone Diagram, showing time occupied in reaching the centre from all parts of the City.

dicated in the list given will furnish all the information required. It is indeed necessary to exercise great discrimination in the collection of statistics, for there are few

undertakings so attractive to those interested in the development of towns, and the inclination to collect interesting facts which have but little bearing upon the actual preparation of a development plan has sometimes to be repressed.

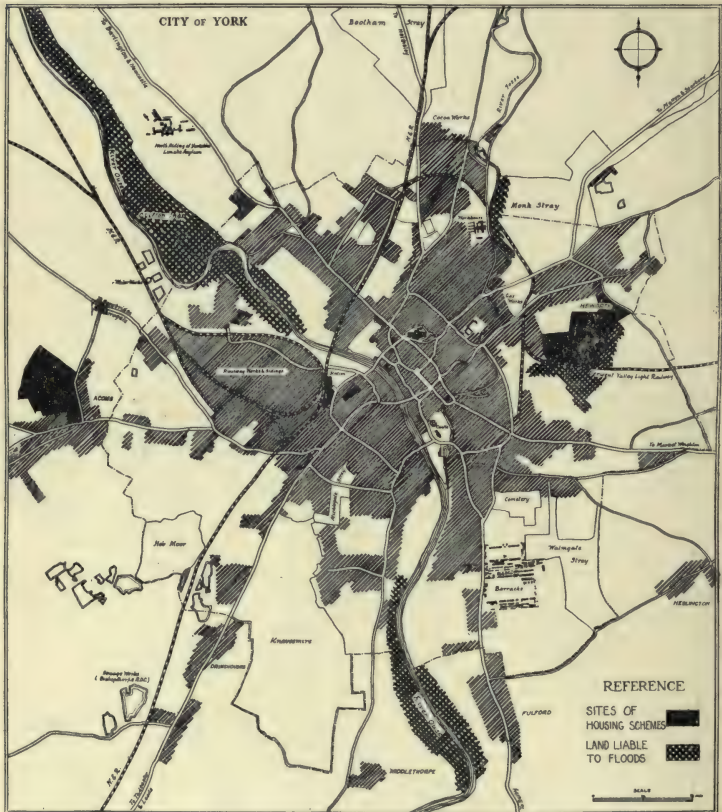


FIG. 6.—City of York: Diagram showing Sites of Housing Schemes and land unsuitable for building on account of liability to floods.

Graphical Representation of Results.—To be of real value in practical planning the information collected must be capable of representation in graphic form in such a way that a complete mental picture of the existing conditions of the town under consideration can be built up by a

series of maps in which simple facts are indicated by a recognised system of notation. Such a series should include maps showing :

1. The contours of the surface.
2. The distribution of the different classes of buildings—houses, industrial buildings, shops, schools, public buildings, etc.
3. Open spaces—public and private—allotments, agricultural land, etc.
4. The distribution and density of population.
5. Traffic facilities—railways, tramways, bus routes, etc.
6. Traffic densities.
7. The distribution of land values.

From the information conveyed by these maps a second series can be prepared to show the relationship existing between the isolated facts of the first series. The second series might indicate, for example :

1. Land unsuitable for building, either by reason of its low situation and consequent unhealthiness or difficulty to drain, or by reason of its steepness.
2. The relation between the place of work and the place of residence.
3. Accessibility of the various Open Spaces and Allotments, as indicated by zones of houses within walking distance, or short tram or bus ride.
4. Accessibility of schools, regarded from the walking distance standard.
5. Time—distance diagram showing the length of journey from all parts of the town to the centre.
6. Accessibility of work centres from residential districts treated in the same manner.
7. Direction and rapidity of the growth of the town.

Figs. 1-6 illustrate examples of such diagrams prepared in connection with a civic survey of York.

These two series of Maps would indicate the more important of the many factors which should be taken into account in considering town development. Subject to such modification as the particular circumstances of the individual case may suggest, they will provide the means of obtaining a reasonably accurate grasp of the existing conditions and probable growth of the town. How the information obtained by means of the Preliminary Survey can be utilised for the solution of particular housing problems will be indicated in subsequent chapters.

CHAPTER III

THE CHOICE OF SITE

THE ultimate success of any housing scheme, whether it be undertaken by a public authority or by a private individual, will depend in large measure upon the judicious selection of the Site. At the present time the acute house shortage and the statutory restriction of rents have combined to produce circumstances in which sitting tenants dare not relinquish their present occupancy, while people who are unfortunate enough to be in need of accommodation are compelled to pay high rents for dwellings which do not satisfy their requirements. Hence the value of inferior property is temporarily inflated. But under normal conditions those houses which are situated in a healthy and attractive position, with convenient access to centres of employment, education, and recreation, will always command higher rents, attract a better class of tenant, and be less liable to remain empty in times of local depression than those not so well placed. The wise location of the scheme will be, therefore, one of the most important factors in determining the economic results by which the success or failure of the undertaking must finally be judged.

CHOICE OF LOCALITY

The process of selecting the site can conveniently be considered in two stages—the choice of the locality or district, and the determination of the actual site within the chosen district. The choice of locality is influenced to

some extent by the same considerations that must be taken into account in deciding upon the character of the scheme : Thus the suitability of the land on the outskirts of the town, the distribution of the need for houses, and the available means of transport, would all have received attention in this connection. But in the majority of towns there will be many districts possessing claims to consideration, and it is intended here to discuss the main principles upon which the choice should be based.

Position in Relation to Industrial District.—Where houses are built expressly for people engaged in the daily task of earning a living, the relative position of their place of work and place of residence is of primary importance. Hence the first question to be considered is whether it is better for the houses to be close to the industrial area or at some distance from it. Both systems have their advantages. The proximity of the residential to the industrial area makes it possible for the employees to walk to and from their work. This is both healthier and, if the town is properly planned, pleasanter than having to travel in a crowded public conveyance. It tends, also, to reduce the cost of living by the amount saved in fares and by the economy of having the midday meal at home. The time saved in transit increases the leisure of the worker, and his capacity to enjoy it is the greater because his daily journey is of a less fatiguing nature. On the other hand, if he lives at some distance from the scene of his labour, the worker experiences a change of environment which is undoubtedly beneficial. There will be less likelihood of nuisance from smoke, smell, or noise emanating from the factories, though modern improvements in smoke consumption and the increasing use of electrical power are rendering the majority of industries less and less objectionable in these respects. In some instances also, sites which are eminently suitable for industries are quite unsuitable for dwellings, and in any case the choice of suitable land

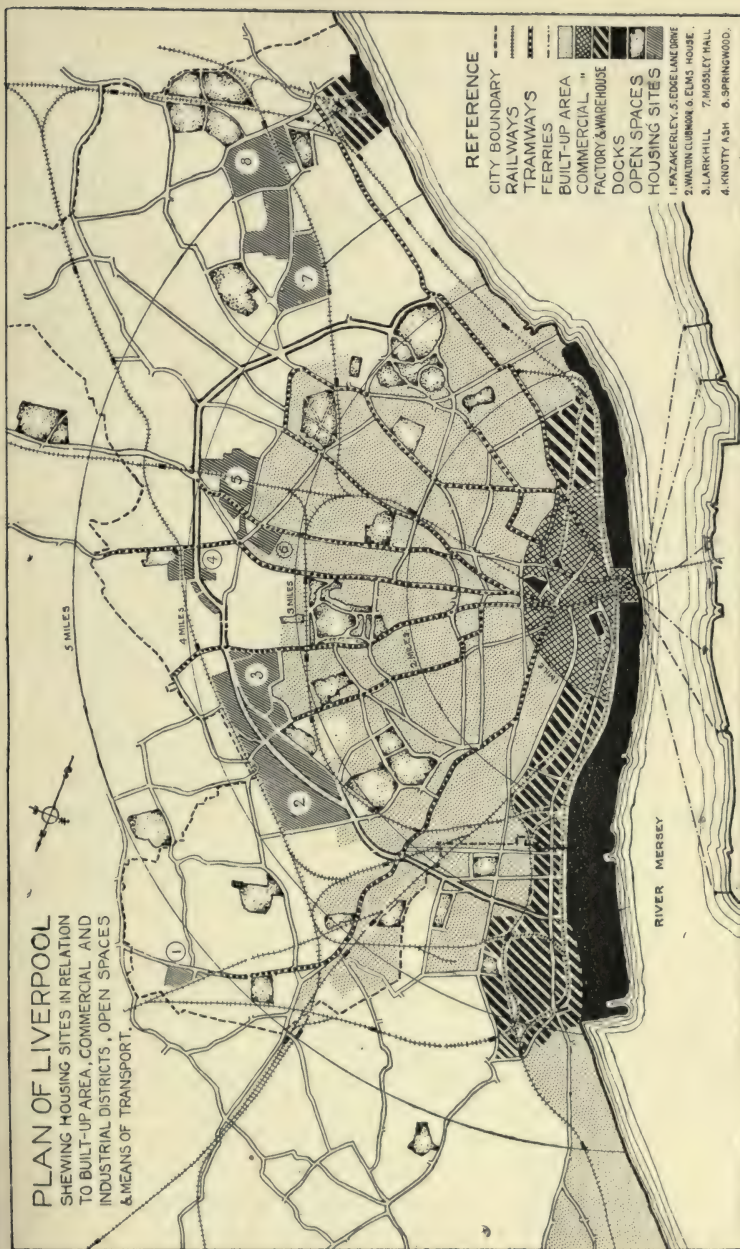


FIG. 7.—Diagram showing disposition of Housing Schemes at Liverpool.

is less restricted if close proximity to the works centre is not essential. Moreover, the farther the housing site is removed from the factory and commercial districts, the cheaper will be the land and the greater the opportunity for economically employing an open system of development with generous provision for parks, playgrounds and allotments.

Need for Houses both Near to and Distant from Factory Area.—It will be seen, therefore, that each method has several points in its favour, and that to some extent the merits of the one are the faults of the other. Those who hold the view that the houses should be adjacent to the place of employment, claim that this arrangement is extremely popular among the workers. On the other hand, the unsatisfactory conditions hitherto associated with residence in the mean streets that usually surround factory districts, coupled with the prohibitive cost—in existing towns—of employing the method of open development except upon their outskirts, has ranged the majority of housing reformers upon the opposite side. The truth of the matter is that neither arrangement can wisely be adopted to the exclusion of the other. The function of a town is to provide for the various needs of its inhabitants, and in the matter of living near their work or at a distance from it there will always be great difference of opinion. Not every one has the leisure or inclination to cultivate a garden, and many would forego the pleasure and profit that others derive from this pursuit in order to live near the centre of the town. But in so far as the majority of the houses now being built under the national housing programme form an integral part of existing towns, the adoption of a general standard of 12 houses to the acre and the consequent location of the building sites away from the industrial areas is justified. For in most of our towns there is plenty of accommodation for those who wish to live near their work, but a deficiency of houses

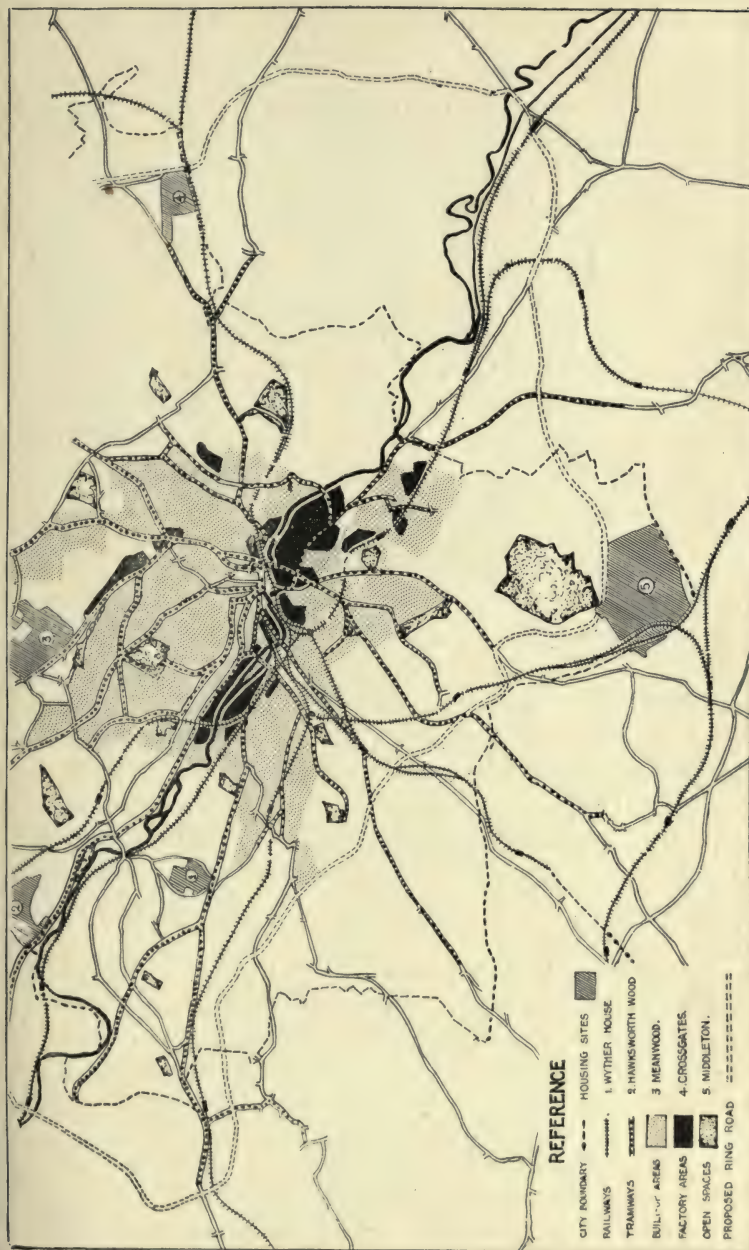


FIG. 8.—Diagram showing disposition of Housing Schemes at Leeds.

with adequate gardens, and the present policy, therefore, meets a definite need. In the general case, however, it will be advisable to place some of the houses near the industrial quarter, and some of them farther away.

Limits of choice defined by Transport Facilities.— Though the disposition of the houses in relation to centres of employment is the most important consideration involved in choosing a suitable district for the housing site, it will be obvious that other circumstances will materially affect the decision. Where it is considered desirable to provide accommodation on the outskirts of a town, or to build new suburbs or satellite towns, the existence of adequate means of transport, or the feasibility of furnishing them without undue expense, will indicate fairly definite limits within which the choice must be made. The distance covered by from 30 to 45 minutes' travelling by train, bus, or tram-car, will give the maximum range from the manufacturing portion of the town, and a map based on the information derived from the City Survey should be prepared to show, graphically, the districts which conform to this requirement. In selecting a district from amongst those available, preference will naturally be given to a neighbourhood possessing the greatest advantages in the way of healthiness, natural beauty, and general amenity for residential purposes.

CHOICE OF ACTUAL SITE

Having settled upon a suitable locality for the housing scheme, it now becomes necessary to select the particular piece of land it is proposed to develop. In this task we shall be guided by the results of a detailed examination of possible sites from the point of view of health, accessibility, cost of acquisition, and economy of development.

Area required.— Before, however, considering the relative merits of individual sites, we must first determine the area of land required. This will depend upon the

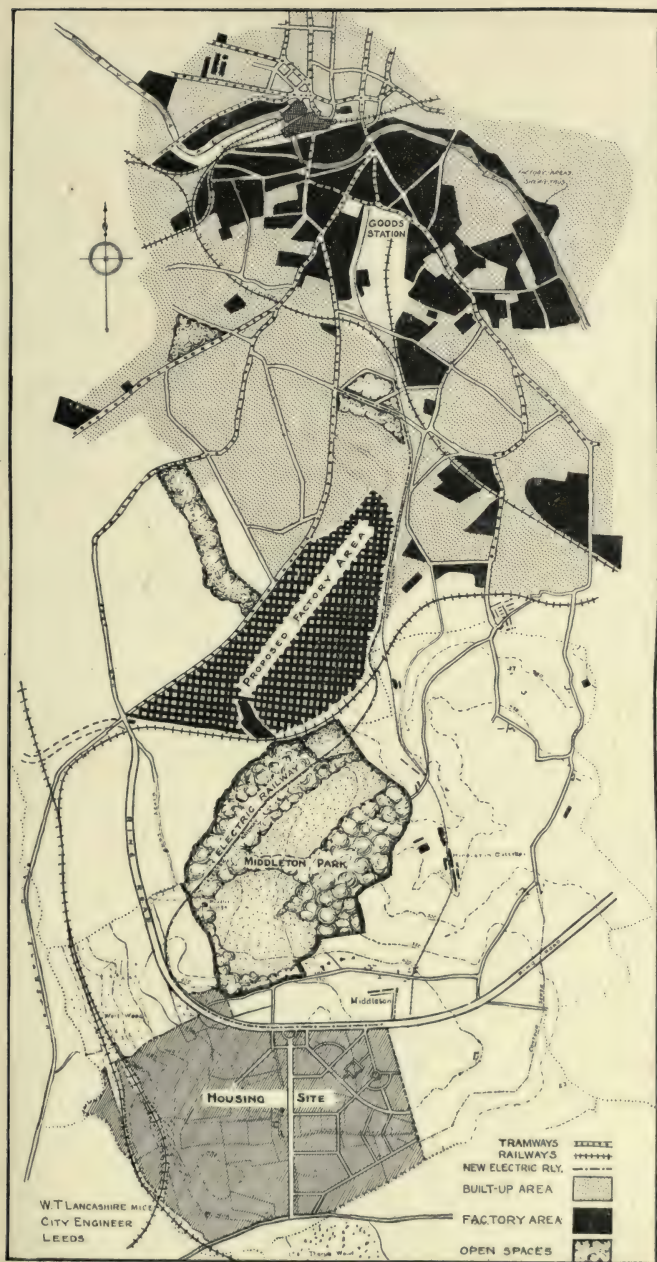


FIG. 9.—Diagram showing position of Middleton Housing Scheme, Leeds, in relation to existing and proposed Factory Areas. Note electric railway connection to the city and the park separating the housing site from the Industrial Area.

number of houses included in the scheme, the building density it is proposed to adopt, and the extra space it may be desirable to acquire for possible future extension or for other purposes not immediately connected with the housing scheme. Generally speaking, it has been found that an area which accommodates the total number of houses at a gross density of 12 to the acre is sufficient to meet all the requirements of an ordinary scheme. But special circumstances, such as the probability of an increased demand for houses in the near future, or the opportunity of securing on favourable terms land which is suitable for a much needed park or recreation ground or other municipal requirement, may make it advisable to acquire land in excess of the area required for housing purposes alone. Where the number of houses allocated to any one district is very large, it should be considered whether the development of several sites of moderate size would not be preferable to the concentration of all the houses into one large colony. In this way greater individuality could be imparted to each group, and a keener sense of local interest stimulated amongst the residents. On the other hand, it must be admitted that greater possibilities of comprehensive treatment are afforded by a large site than by a small one. But whichever policy is followed—and this will be dictated chiefly by the character of development adopted—it should be borne in mind that it is highly undesirable to cover large tracts of country with houses unless there is some division into smaller units, such as wards, adequately defined by belts of open space, parkways or other suitable means.

Conditions requisite for Health.—Every one will agree that the site should be healthy; whatever advantages it may possess in other directions should not be allowed to compensate for failure to satisfy this condition. The circumstances which make for healthiness in a building site are largely relative in character, and it must not be

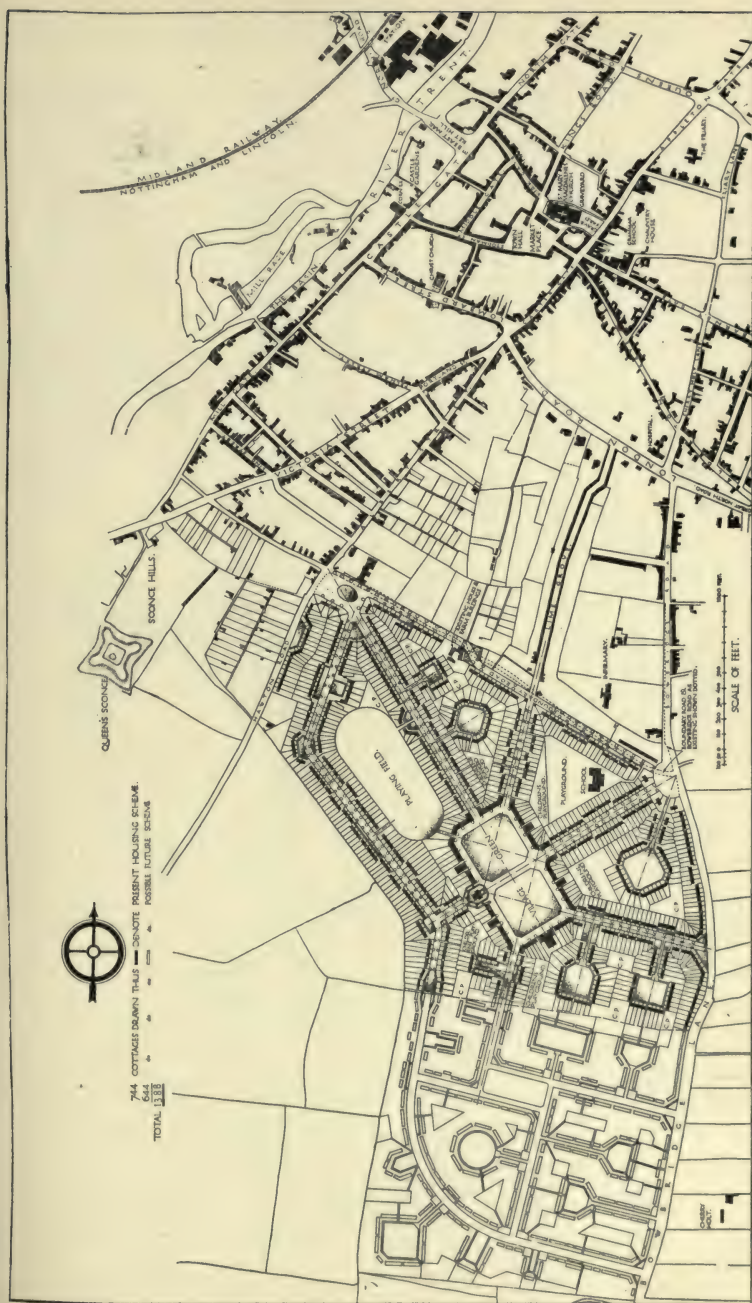


FIG. 10.—Housing scheme at Newark-on-Trent, showing position in relation to existing town. Lay-out designed by Barry Parker.

assumed that qualifications which would be regarded as essential in one case are necessary in all cases. Thus, while an elevated position would be desirable in a hilly district in order to escape dampness and the fogs which accumulate in the valleys, in a plain the disadvantages of a low altitude would largely disappear. Again, in the matter of subsoil it is preferable to choose a light, well drained formation, such as gravel, limestone, or chalk; but in many districts it would be unreasonable to reject a site because it was situated on clay. Risk of subsidence in mining areas is another difficulty which has to be met by a certain elasticity of method. While every effort should be made to avoid land subject to this risk—and it will be remembered that this was one of the factors which influenced the South Wales Regional Committee in making their recommendation that Housing Centres should be established away from the coal measures altogether—it is sometimes impossible to find within reasonable distance a site immune

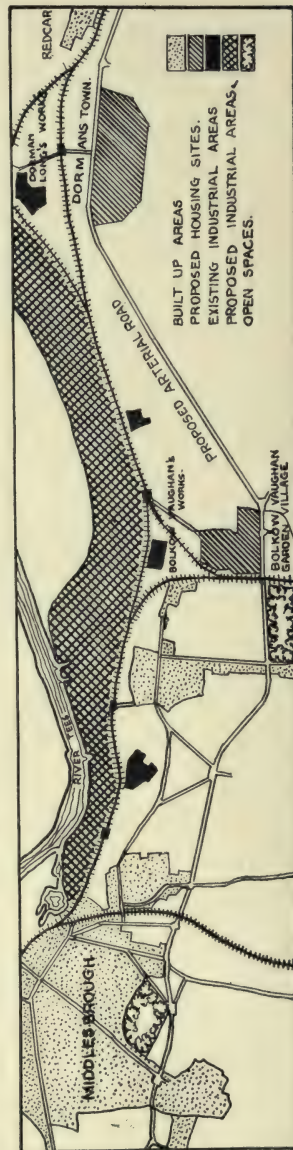


FIG. 11.—Diagram showing relative position of Industrial Areas and Housing Sites in the South Tees-side region.

from danger in this respect. In these circumstances there is no alternative but, in consultation with a mineral expert, to choose a site which is exposed to the minimum risk and to take such additional precautions in building as may be considered desirable. But if attention has been drawn to certain conditions affecting the healthiness of the site, the complete fulfilment of which is not always practicable, it is all the more desirable to emphasise the necessity for insisting that every site should satisfy at least one requirement, namely, that there should be no risk of dampness either from the seasonal variation in the level of the subsoil water, or from inundation by rivers or streams in times of flood.

Topographical Considerations.—Not strictly a matter of health, but closely allied thereto, is the question of amenity. The general amenity of the district was referred to as one of the factors influencing its choice, but it will often happen that within the district the available sites vary considerably in natural advantages. Subject to considerations of economical development, referred to in a later paragraph, sites which are undulating in character or which possess well-grown trees and hedges, or ponds and streams that could be made use of to increase the attractiveness of the houses and their environment, are to be preferred to those not offering these possibilities. In hilly country, the aspect of the site is an important consideration ; a northerly aspect is always undesirable, and land falling steeply in this direction is quite unsuitable for residential purposes. Fertility of the soil is a matter which ought not to be overlooked, particularly where considerable importance is attached to the provision of gardens, while the nature of the immediate surroundings should receive careful attention, in order to avoid proximity to buildings or works of a detrimental character.

Accessibility.—Accessibility to the industrial part of the town has already been urged as a requisite of the

district in which it is proposed to locate the scheme. But accessibility to Shops, Schools, and Places of Entertainment or Recreation is almost equally important, particularly in the case of the smaller schemes depending mainly upon existing facilities in this direction. It is also most desirable that the actual approach to the site should be of reasonable width and directness, such as to afford a suitable and dignified entrance to the estate.

Facilities for Water Supply, Drainage, etc.—The position of the site in regard to existing sewers, sewage disposal works, water, gas, and electric light mains is an important consideration. Unless these services are reasonably accessible, the enormous cost of extending them for even a short distance would saddle the scheme with a burden it could not carry. Except, therefore, in completely rural areas, where these urban amenities are not considered so essential, this condition must be regarded as a *sine qua non*. The question of an adequate supply of water, however, is as important in the country as in the town, and frequently more difficult to obtain. It is particularly necessary, therefore, to be satisfied that a supply of water of adequate quality and quantity is procurable before the final selection of a rural site.

Economy of Development.—Among sites which are suitably placed in other respects, those will naturally be selected which can be developed in an economical manner. Many factors help to determine the cost of development. Sites which are low lying and quite level usually entail extra expense in the provision of deep sewers and possibly of pumping plant. On the other hand, steep, hilly land, especially where there are many local irregularities of surface, involves additional expenditure in road making, in sewerage, and in the foundations for the houses. A site which is sufficiently undulating to admit of convenient drainage and not too rugged for economy in road making, may be considered to approach the ideal. The shape of the

site is another factor which affects the cost of development. If the boundaries are very irregular, it is usually impossible to lay out the land to the best advantage. It is therefore advisable to secure a reasonably compact area.

Consideration also should be given to the question of subsoil, as apart from its effect upon the healthiness of the site, it influences the cost of development to a greater extent than is commonly appreciated. With a reasonably firm subsoil such as gravel, the minimum of expense is incurred in the foundations of buildings and in the construction of roads and sewers. A clay subsoil, on the other hand, increases the cost of development in many directions. The foundations of buildings resting upon it are liable to give way owing to the shrinkage of the clay in dry weather and its expansion in wet weather, and it is necessary in some cases either to build the houses on rafts (an expedient which has been adopted at Tilbury) or else to carry the foundation to a considerable depth in order to secure the necessary stability. Extra precautions have to be taken in the construction of roads to prevent the clay working up through the hardcore and causing rapid disintegration of the surface ; while it becomes necessary to encase the sewers in concrete in order to avoid the unequal settlement and subsequent fracture of the pipes. Where the subsoil is rock, expense in foundations both for houses and roads is usually reduced to a minimum, but considerable expense will be incurred in excavating trenches for the sewers and other mains.

Partially developed Sites.—A further consideration of greater importance in districts where land has already been partially developed, is the existence upon a site of road frontage upon which houses can be built at once. Where such roads exist, and do not preclude the economical development of the remainder of the site, much time and expense can be saved by incorporating them with the

proposed scheme. In this connection, however, it should be remarked that sites which, by virtue of their position, will be cut up unduly by main roads for through traffic should be avoided.

Cost of Land.—The cost of the land and the ease of acquisition are both important factors in the choice of site. While it is desirable to secure land as cheaply as possible, it is more economical to pay a higher price for really suitable land than to buy cheap land which fails to satisfy the foregoing requirements to any marked extent. The average price paid for the land under the Government Housing Scheme is approximately £180 per acre, the average cost of development (*i.e.* construction of roads and sewers) about £50 per house, or £600 per acre, and the average cost of building, say £850 per house, or £10,200 per acre. Out of a total cost of £10,980 per acre of the Housing Scheme, therefore, the amount attributable to land was only £180, or considerably less than 2 per cent. And even if, admitting the cost of building and road making to have been altogether excessive during the period when the Government Scheme was in operation, pre-War figures of £250 for a cottage and £25 per house for development charges are taken, the cost of land only rises to 5 per cent. of the total expenditure. It will be clear, therefore, that a comparatively small increase of expenditure upon development or house foundations will quickly wipe out any saving there may be in the first cost of land which cannot be laid out economically.

The examination of possible sites will soon show that none of these possess all the ideal attributes, and that the selection must finally be made on a comparison of their relative advantages and disadvantages. In this process rough estimates of the cost of acquiring and developing the different sites under consideration will be found of great assistance. But the final verdict, while giving due weight to economy in initial expenditure, will also take

into account the permanent value—less easily estimated in terms of money, but financially effective nevertheless—of those qualities of healthiness, convenience, and amenity to which reference has been made in the preceding pages

CHAPTER IV

THE DEVELOPMENT PLAN : PRELIMINARY CONSIDERATIONS

GENERAL REQUIREMENTS

THE preparation of the Development Plan for a Housing Scheme ordinarily includes the laying down of a system of roads designed to serve the requirements of traffic and to afford means of access to the houses ; the determination of the lines of drainage ; the division of the land into individual plots, and the arrangement of the houses thereon ; and the reservation of such sites as may be needed for open spaces, shops, schools, and other buildings of a public or semi-public character. In the case of very large schemes, especially where these are in the nature of self-contained suburbs or small towns, it may be necessary to consider the allocation of land for industrial purposes, and generally to take a wider view than is commonly adopted in the development of housing sites. But as the allocation of areas for different uses is clearly a function of Town-planning as distinct from Site-planning, it is not here proposed to extend the already wide limits of our subject by attempting to examine the principles which govern the disposition of the various parts of the town. For our purpose, therefore, it will be assumed that the site has been chosen with due regard to its position in relation to the proper development of the town as a whole. This will greatly simplify our task, but it will not leave us entirely free to plan the site as though it were an isolated unit. There is no point at which it could be said that Town-planning ended and Site-planning began ; they are both phases of the same process. Yet there is a distinct difference in function between the two,

which may be expressed by saying the former is concerned with the convenient arrangement of the town in general, and the latter with the convenient arrangement of one small part of the town in particular. In planning a housing estate, however, these functions are merged to the extent that the convenience of the citizens as a whole will be the determining factor in deciding upon the main lines of the development, while the localised requirements of the prospective resident and the conditions peculiar to the actual site will be the predominating influences in the preparation of the detailed lay-out.

Provision necessary for Social and other Needs of Community.—The site should be regarded from the outset as the future location of a community having many needs in addition to that of house-room. It is not enough merely to cover the ground with houses and streets; adequate provision must be made for parks and playing-fields and all those public and semi-public buildings which are required for the enjoyment of a full measure of social life. Religious needs demand the reservation of sites for churches, chapels and halls in connection therewith. Schools with properly equipped playgrounds are also indispensable. Institutes, clubs, reading-rooms, libraries, cinemas, cafés, and inns, all play an important part in the social life of the community and must not be ignored, while provision for shops, markets, public garages, and such domestic industries as laundries, joiners' and plumbers' workshops and builders' yards will be necessary in the majority of cases. The size and character of the scheme, and its proximity to an existing urban centre, will regulate the extent to which it is desirable to make provision for these auxiliary needs; the larger the scheme the more varied will be the requirements, and few schemes are so small that houses constitute the sole desideratum.

Data for estimating Probable Requirements.—Before proceeding to consider the laying out of the estate, it will be necessary to make an estimate of the number and

extent of the sites which it is desirable to reserve for such purposes as have been mentioned. The data available for this calculation are, at the present time, a good deal less extensive than could be wished, but some information can be gathered from such statistical publications as the Census returns, the recommendations of special organisations—as, for instance, those of the Juvenile Organisation Committee with regard to the area of open space required in proportion to the population¹—and, finally, the results of local City Surveys. The Census returns in particular contain much useful information as to the proportion of different classes of buildings in every town and the numbers of people who live in the various kinds of dwellings—ordinary dwelling-houses, flats, shops, etc. Thus the following table extracted from the return of 1911 will give some idea of the proportionate number of buildings—other than houses—which occur in different sized communities :

TABLE I.—AVERAGE NUMBER OF BUILDINGS OF VARIOUS KINDS PER 100,000 POPULATION

	Places of Worship.	Government and Municipal Buildings (including Schools).	Theatres and Places of Amuse- ment.	Shops.	Offices and Ware- houses.	Hotels, Inns, and Public- houses.
England and Wales	139	29	8	1598	525	243
Urban Districts (including Boroughs)	81	25	9	1815	565	210
Rural Districts	344	43	7	823	385	358
County Boroughs separately	69	20	7	1982	628	209
Urban Districts separately	104	34	12	1718	501	235
LONDON	45	13	6	1690	607	144

¹ It is estimated by this body that a minimum area of $2\frac{1}{2}$ acres per 1000 persons is required for playing fields. The allowance of $1\frac{1}{4}$ places per family, usually made in estimating the accommodation required in elementary schools, may also be quoted as an example of the kind of data here referred to.

It will be noted that the figures for each class of building vary considerably as between the different local government units. As might be expected, those for the Urban Districts taken separately approximate most nearly to the general average, while those for the Rural Districts show the greatest discrepancy. The outstanding feature of the table, however, is the extraordinarily high proportion of places of worship, Government and Municipal Buildings, hotels and inns, and the almost equally low proportion of shops in the case of the Rural Districts as compared with any of the other groups. Though it might have been anticipated that the tendency would be generally in this direction, the actual figures are rather startling. No account, of course, is taken in these statistics of the size of the various buildings, so that as far as accommodation is concerned it is sometimes misleading to make comparison between the rural district on the one hand, where the population is scattered and there is in consequence a large number of small buildings, and an urban district on the other hand, where the population is concentrated and the buildings are fewer but much larger. In estimating, however, the *number* of sites to be reserved for special purposes the figures given will be of service. But the ratio between the number of special buildings and the population varies not merely with the degree of concentration, but also according to the kind of town. The following table shows the average figures for towns in three different categories: *Industrial Towns* such as Leeds, Liverpool, Manchester, and Birmingham; *Country Market Towns* like Ipswich, York, Exeter, etc.; and *Health Resorts* such as Bath, Bournemouth, and Harrogate. Without going into too great detail, certain definite characteristics are worth noting. It will be observed, for example, that the number of theatres and places of amusement is considerably higher, and the number both of shops and places of worship slightly higher, in the case of Health Resorts than in that of the other two classes. The pro-

portion of industrial buildings in this type of town is, of course, distinctly lower, but it is rather surprising to find that there are fewer hotels than in the Country Market Towns. The latter are particularly well furnished in this respect and also in the number of institutions, public buildings, and private offices; speaking generally, they are well equipped all round. The Industrial Towns naturally have a high proportion of warehouses, factories, etc., and

TABLE II.—AVERAGE NUMBER OF BUILDINGS OF VARIOUS KINDS PER 100,000 POPULATION—IN TOWNS OF DIFFERENT CLASSES

	Places of Worship.	Government and Municipal Buildings.	Theatres and Places of Amusement.	Shops.	Offices.	Warehouses and Factories.	Hotels, Inns, Public-houses.	Institutes (including Schools).
Industrial Towns, average population 400,000	69	19	55	2041	103	535	188	52
Country Market Towns, average population 55,000	94	31	77	2010	146	480	293	167
Health Resorts, average population 50,000	96	24	119	2219	80	314	212	104

an average number of hotels, shops, offices, and places of amusement, but are below the mean figures in regard to institutions, places of worship, and government and municipal buildings. Shops are the only kind of buildings which occur in anything approaching a constant ratio to the population; it will be noted that amongst the three kinds of towns selected for comparison there is a maximum variation of less than 10 per cent. But even in this the most consistent of the ratios, the variation as between urban and rural districts is very great—the proportion

being roughly as 2 is to 1—while as between individual places the discrepancy is even more noticeable. Hence, although these general figures are useful as an indication of the requirements of towns in the foregoing matters, the actual estimate in any particular case should be based principally upon the data derived from the City Survey. By taking as a basis a ward or other area occupied by a population similar to that for which the housing scheme is to provide—and of which the number of inhabitants is known—it will not be difficult to ascertain the number of special buildings normally associated with a given number of people in the town under consideration, and hence to estimate with some accuracy the needs of the Housing Scheme.

Economic Advantages of making Adequate Provision for Auxiliary Purposes.—There is nothing Utopian about the reservation of land for open spaces, public buildings, and shops ; on the contrary, it is a sound financial investment. For all these things will make their appearance in due course, and it is obviously more economical to reserve suitable sites at the original value of the land than to wait until the district is built up, when land for these purposes is obtainable only with great difficulty and at greatly enhanced cost, and even then not usually in the most suitable positions. The provision of sites for many of these purposes would not only be a great advantage to the inhabitants but would be a financial benefit to the scheme. In a district where some thousands of people are residing a considerable economic value is conferred upon sites for shops, cafés, cinemas, and similar undertakings, especially if they have been chosen with care, and the enhanced prices or rents obtainable for these sites will help to pay for some of the equally necessary but non-revenue producing features of the scheme.

Special attention should also be given to the provision, in large housing schemes, of areas for houses of a greater

size than the general average. From a social point of view it is most desirable that people of different classes and different occupations should live together, and that provision should therefore be made for a fair proportion of houses suitable for doctors, professional men, and people of other callings, many of whom will be glad to avail themselves of the opportunity of living in a district where the amenities have been preserved and enhanced by careful planning. It will usually be possible to secure, either by sale or lease of sites for such houses, an economic return which will be of benefit to the scheme as a whole.

While it may not be practicable actually to build the larger houses or the public buildings as an integral part of the housing scheme, there is every advantage in reserving sites for them. It is better, indeed, that the provision for these needs should err on the side of being too ample. For if the reservation prove to be excessive, it is an easy matter to build houses on those sites which are not required, but it is very difficult to find additional accommodation if sufficient has not been set apart in the first place.

TOPOGRAPHICAL SURVEY OF THE SITE

Nature of Information required.—From the point of view of economy, no less than from that of convenience and attractive appearance, successful development will depend upon full advantage being taken of all the opportunities which the site itself affords. This is especially true of undulating land, but few sites are quite flat, and there are scarcely any that do not possess some feature which influences the design. Hilly sites offer greater opportunities for skilful treatment not only in securing the charm associated with roads winding along the contours or following the natural gradients of the ground, but, by careful adaptation to the levels, in saving considerable expense in the construction of roads and sewers and in the

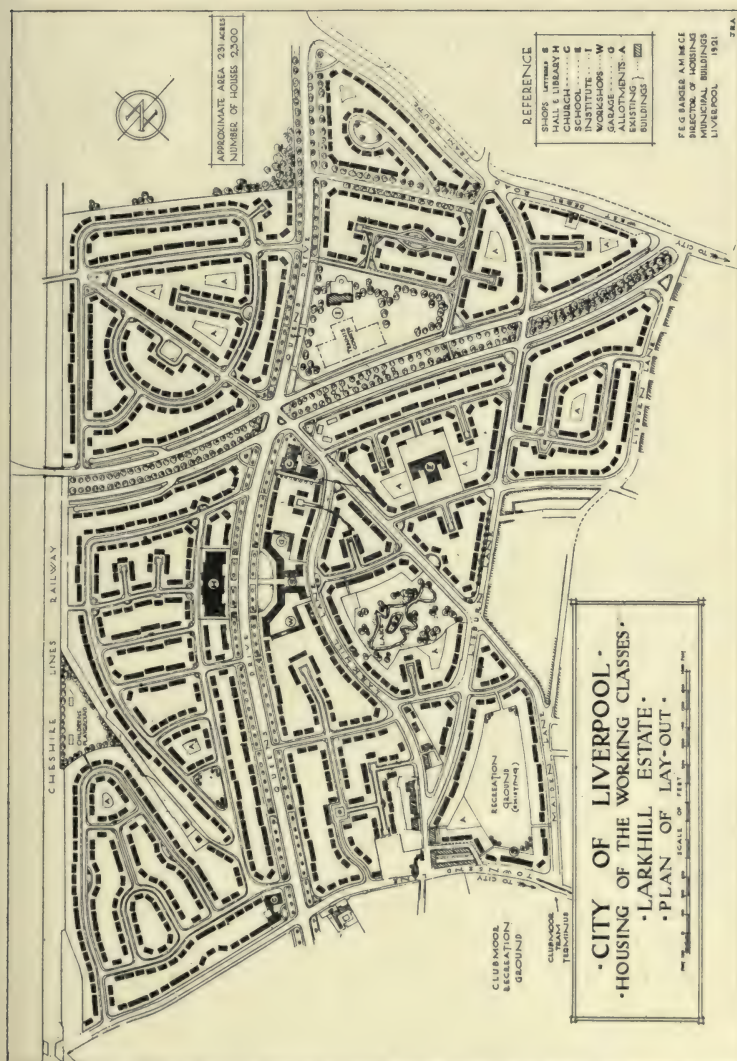


FIG. 12.—Plan of Larkhill Estate, Liverpool. F. E. G. Badger,
Director of Housing.

The lay-out of both this and the other Liverpool Schemes illustrated in Figs. 13 and 14 is greatly influenced by the routes of proposed Arterial Roads.

foundations of houses. The topography of the area will affect the lay-out in many ways. A level spot may suggest the location of a playing-field in a position which influences the entire plan ; a hill may be of just the right degree of prominence to form a natural focal point ; a clump of trees or a well-grown hedge may suggest the position for a park or the line of a road. In order, therefore, that all such natural characteristics of the site may be utilised to the full advantage, it is essential that a careful survey of the ground should be made before any planning is attempted. This should include—in addition to the essentials of a land survey—the taking of sufficient levels to permit of the accurate plotting of contour lines at vertical intervals of not more than 5 feet (or 2 feet if the land is fairly level),¹ frequent surface levels of any roads existing upon or surrounding the site, and the size and invert levels of all sewers into which it may be necessary to drain. The position of all woods, small groups of trees and individual specimens which are worth preserving, should be accurately located on the plan with a note as to size, species, and condition. Similarly all well-grown hedges should be marked, and natural features, such as quarries or sandpits, streams and ponds. Information with regard to the depth of the top soil and the nature of the subsoil will be useful both as a guide to the provisions it will be necessary to make for the foundations of the houses and the formation of the roads and sewers, and also as an indication of materials, found on the site, which could be utilised for constructional purposes.

Survey should extend beyond Limits of Actual Site.— It will frequently occur that existing buildings, distant views, or undulations of the ground outside the area imme-

¹ The closer intervals are frequently recommended for use only in the case of *hilly* sites. But it will be found that while 2-feet contours are essential to indicate the surface variation of comparatively level ground, the configuration of undulating land is represented with sufficient accuracy by 5-feet contours.

diately to be developed constitute important elements in the design of the lay-out plan. In order, therefore, that

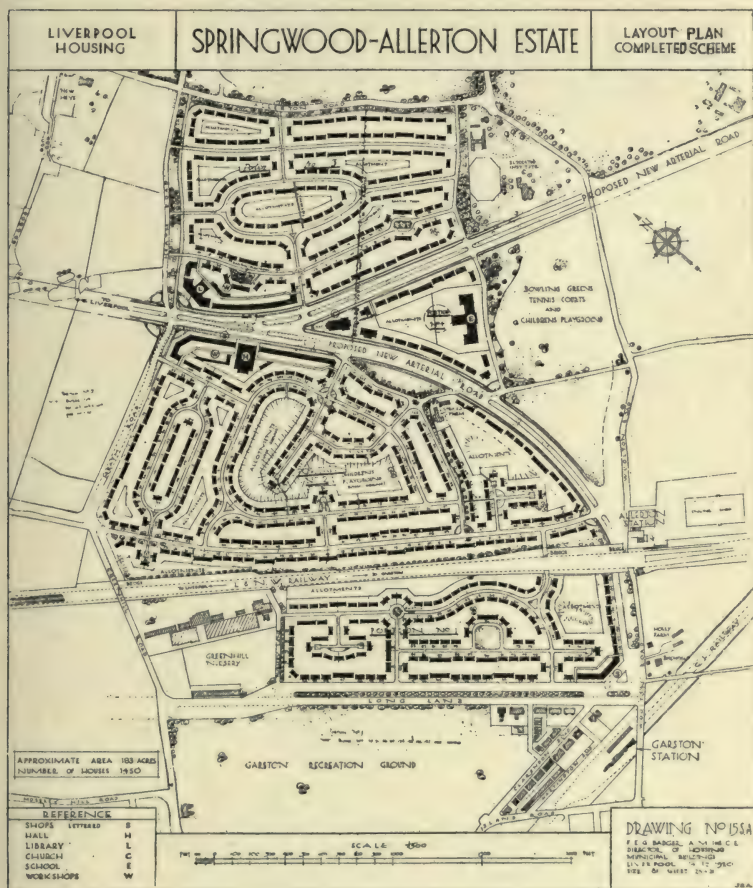


FIG. 13.—Plan of Springwood-Allerton Estate, Liverpool.
F. E. G. Badger, Director of Housing.

See note to Fig. 12.

due consideration may be given to the surroundings, it will usually be advisable to extend the survey beyond the boundaries of the actual site,

Survey Plans.—The scale to which the results of this detailed survey of the site should be plotted will vary with the size of the scheme and the physical characteristics of the land. It will usually be found convenient to make use of maps published by the Ordnance Survey Department as the basis for these plans, and to some extent, therefore, the scale will be regulated by those officially adopted. All ordinary requirements are met, however, by one or other of the three standard scales— $1/2500$ (208·33 feet to the inch), $1/1250$ (104·166 feet to the inch), and $1/500$ (41·66 feet to the inch). Of these the first is the most suitable for the preliminary work upon the lay-out of large schemes. For projects of moderate size, $1/1250$ th is a more satisfactory scale, while for quite small developments and for the detailed planning of the larger areas $1/500$ th of full size best serves the purpose. The topographical survey, therefore, should be plotted to whichever of these scales is likely to be the most useful having regard to the circumstances of the particular case.

INITIAL STAGES OF THE DEVELOPMENT PLAN.

Provision of Routes for Through Traffic.—Having acquired the necessary information as to the requirements of the scheme and the topography of the site, we can now proceed to consider the preparation of the development plan. The initial step in this process is to lay down the lines of any roads which may be required for purposes of through traffic. Subject to such deviations as may be desirable to secure easy gradients, these roads should be as direct as possible. This does not necessarily mean that they should be of uncompromising straightness. The requirements of modern traffic render excessive curvature or sudden bends undesirable, but without infringing the convenience of the motorist it is quite possible to lay down perfectly satisfactory arterial roads without adopting the

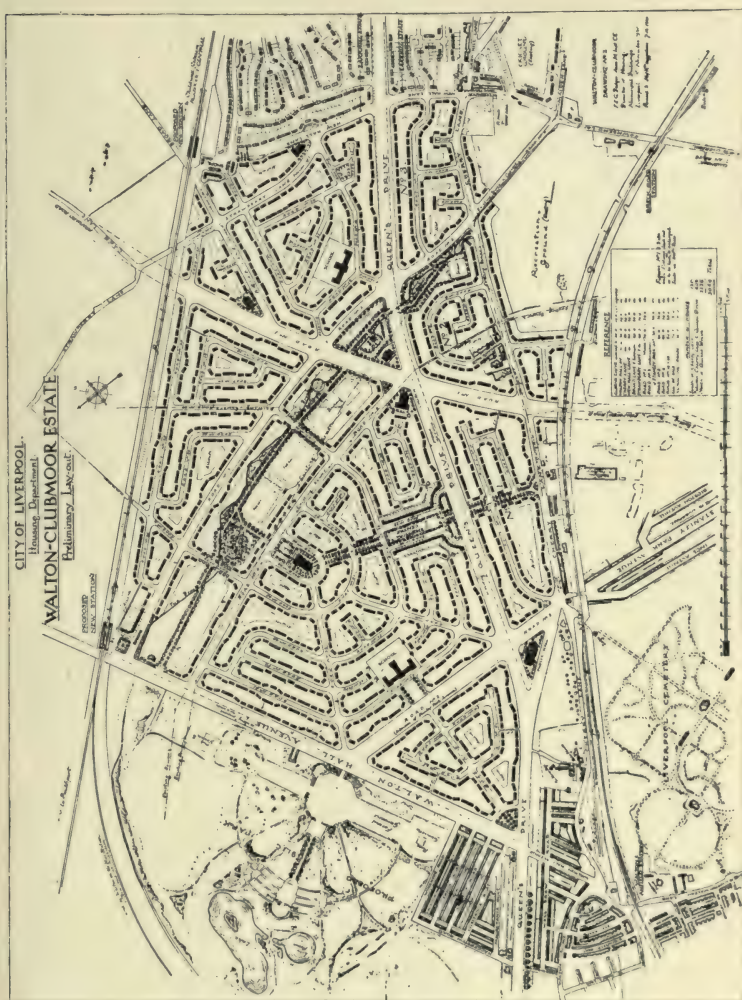


FIG. 14.—Plan of Walton-Clubmoor Estate, Liverpool.
F. E. G. Badger, Director of Housing.

See note to Fig. 12.

inflexible rectilinearity which characterises the proposals of so many of our traffic experts. In the streets of a town it must be recognised that the requirements of *fast* traffic are not the sole consideration ; due weight must be given to the architectural claims of the buildings to which they give access and to the sensibilities of the pedestrians who use their pavements. Nothing is more dispiriting than to be compelled to walk down a perfectly straight street that extends apparently to infinity in vanishing perspective. There is nothing by which to mark one's progress, no goal to be attained, and no change of view ; if the direction of the street, moreover, happens to coincide with that of the prevailing wind, there is no shelter from the storm. Hence in laying down the lines of such traffic roads as must pass through the scheme, it is well to remember that while directness and easy gradient are the primary considerations, little is lost in convenience and much is gained in attractiveness if it can be arranged that, in the absence of special circumstances, no vista should exceed a distance of about half a mile.

Disposition of the Component Parts of the Scheme.—

The position of the arterial roads will exert considerable influence upon the location of the different parts of the scheme—the land to be reserved for open space, different grades of houses, etc., and the placing of the civic centre.

Areas for Houses of Different Classes.—As a general rule it is good practice to place the smaller and less expensive houses in the areas most closely associated with the transport services, *i.e.* near the main roads ; the medium-sized houses rather farther away but still within easy distance of them ; and the larger houses—the occupants of which will be less dependent upon public means of conveyance—in the more remote and therefore more secluded districts.

Local Centre for Shops and Civic Buildings.—The precise conditions which are most favourable to the establishment

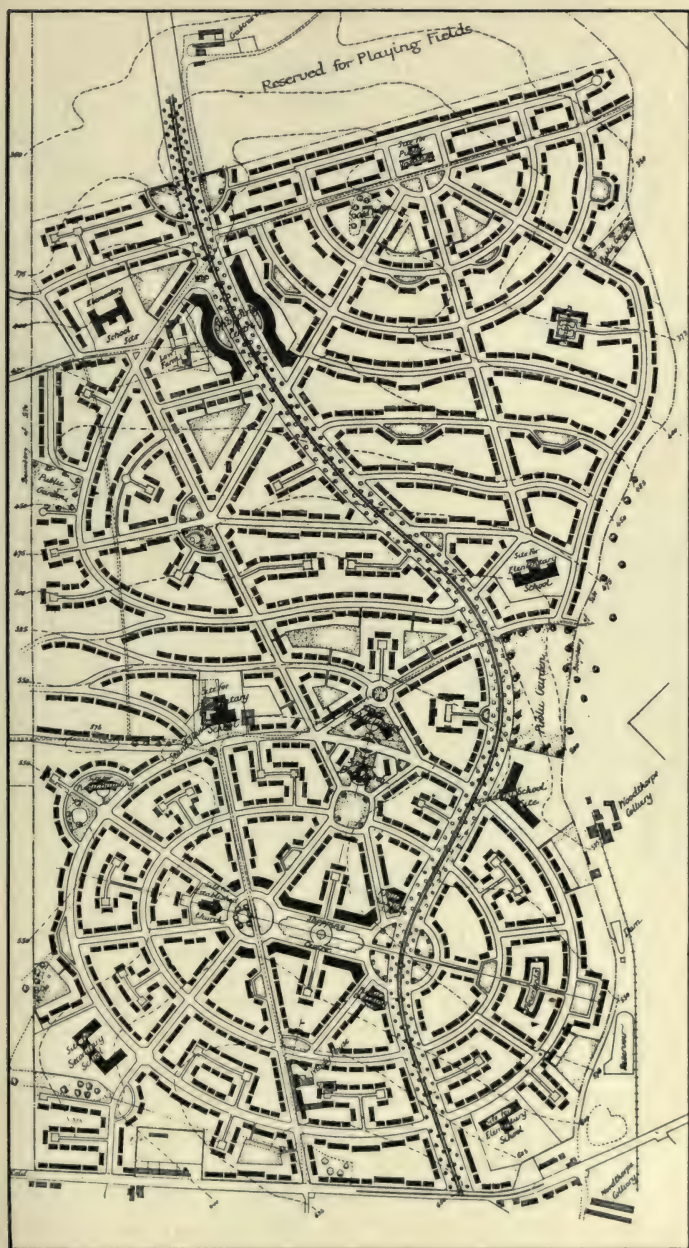


FIG. 15.—Lay-out of Manor Estate, Sheffield. F. E. P. Edwards, City Architect.
Note provision of route for Arterial Road through Scheme.

of retail trade are still the subject of a certain amount of speculation, but it is generally agreed that the grouping of shops to form a "market" is one of the principal factors of success. The best position for such a shopping centre will depend very much on local circumstances; it may safely be assumed, however, that proximity to a main road is essential. Probably the most advantageous situation will be just off an arterial road, though in full view of the



FIG. 16.—Market Place, Bungay.

traffic using the latter, and in such a position with regard to the residential areas that the inhabitants must almost necessarily pass through it in their journeyings to and from the town or about the district. In housing schemes it will usually be advisable to combine the group of shops, or the principal group if more than one, with such public or semi-public buildings as may be required to form a local centre where the people of the district will meet for a variety of purposes, and local interest and pride of citizenship will be encouraged. The market squares of many of our old

country towns and villages (see Figs. 16-18) afford admirable examples of the combination of shops, inns, municipal buildings, churches, public halls, etc., with private houses, which might well be adapted to the needs of the present day. There are great advantages in combining public buildings, shops, and ordinary houses in the central *place* of a housing scheme. Few schemes will be so large that



FIG. 17.—Market Place, Amersham.

their requirements in the way of public buildings would fill even the most modest square, and, of these, buildings such as schools, for example, are not best situated in such a position. The civic centre of a residential district differs, also, from that of the whole town, inasmuch as the activities connected with its public buildings are more in evidence in the evening than during the day. Hence if a rather deserted appearance—which is the very antithesis of a civic centre—

is to be avoided, it will be wise to group both shops and dwellings with the public buildings. This would mitigate, to some extent, the derelict stage through which these centres usually pass before the sites are occupied by the buildings for which they have been reserved. Another method of meeting the latter difficulty would be to arrange a public park or garden in connection with the *place* so that, in addition to its final area, it occupies, to begin with,



FIG. 18.—Market Place, Alfriston, Sussex.

frontage which will eventually be taken up by buildings. This suggestion has the merit of combining temporary expediency with permanent value. For the small park attached to the business centre is always greatly appreciated and therefore permanently needed, while if it is allowed to occupy vacant building sites until they are required, they will, instead of being an eyesore, become a source of pleasure.

Subsidiary Centres.—The size and the estimated re-

quirements of the scheme will determine whether subsidiary centres are needed. Unless a very large population is to be provided for, it is usually better to concentrate upon one main centre than to dissipate the interest which attaches to groups of public buildings by scattering them too much. At the same time there are certain buildings which are not suitably accommodated in a civic centre ; for these either subsidiary groups or isolated sites will have to be arranged.

Educational Buildings.—Schools are much better placed away from the noise and bustle of the centre and of the arterial roads, in a position where it is reasonably quiet and where sufficient land can economically be provided for adequate playgrounds. There is a good deal to be said for putting schools in proximity to the public recreation grounds and playing-fields, especially if the school playground were available for use during out-of-school hours. The advantages of this arrangement are that the school is surrounded by a greater extent of open space, which is not only healthier for the children but renders their natural exuberance of spirits less disturbing to the occupants of the neighbouring houses. It would also permit greater use to be made of the recreation ground by the children at a time when it would not be frequented by other people, while if circumstances were favourable to the establishment of a swimming pool in connection with the recreation ground this would be a most valuable adjunct to the school and would be none the less conveniently accessible for the rest of the community.

Places of Worship.—Places of worship, also, are buildings which cannot suitably be grouped. A single church may very happily be placed in the central square, but there would be something utterly incongruous in having four or five denominations housed in close proximity. The complications of life, to which the present multiplicity of creeds gives rise, are reflected to a certain extent in the difficulties

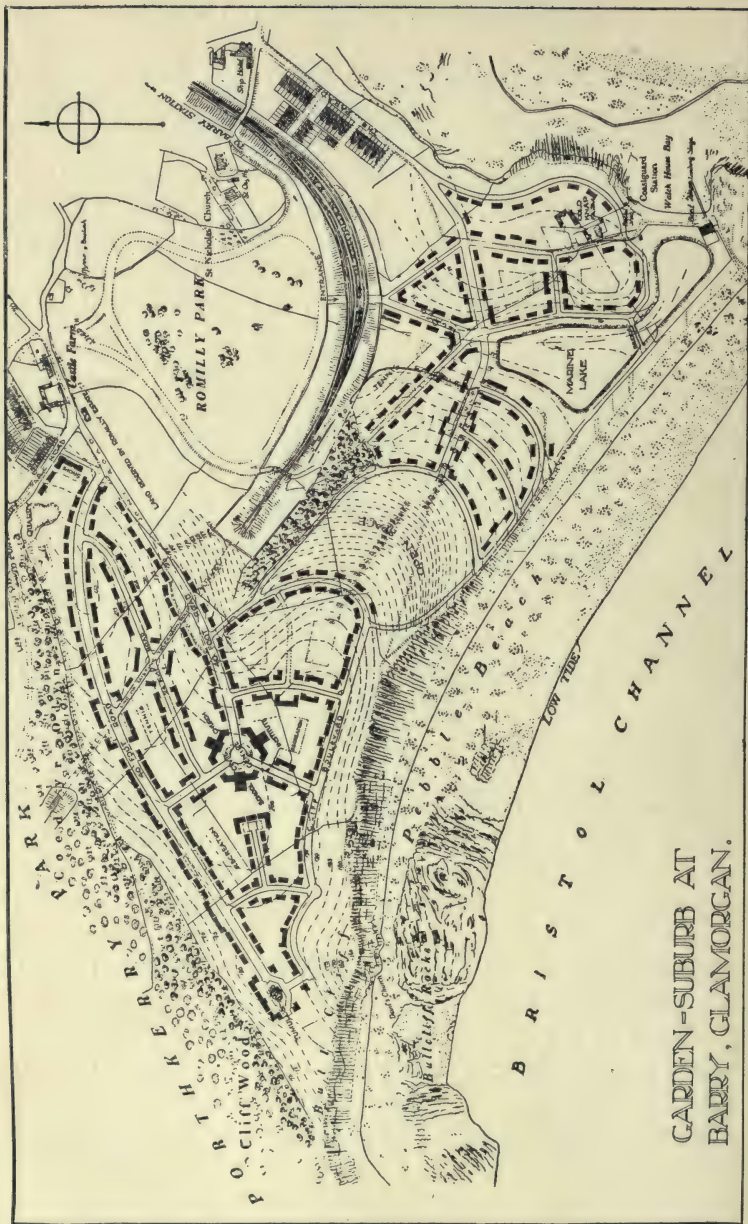


FIG. 19.—Lay-out of Barry Garden Suburb, designed by Alwyn Lloyd in consultation with Raymond Unwin.

created in the sphere of town planning. It would be a simple matter, in the days when there was a common creed, to choose the best site for the church which was then the natural focus of the social life of the people. But now it is a very different matter, for, far from religious belief being the common meeting-ground, it is unfortunately



FIG. 20.—Lay-out of Hawksworth Wood Scheme at Leeds.
W. T. Lancashire, City Engineer.

more often the field of dissension, and great care has to be exercised in locating sites for places of worship to avoid wounding the susceptibilities of the different religious bodies by either preferential treatment or undue proximity. The most that can be attempted is the reservation of sites sufficiently large to admit of a satisfactory grouping of the church or chapel, the mission hall and the minister's house. Such sites require a certain prominence, as the

buildings for which they are reserved play an important part in the lives of the various congregations and ought therefore to occupy an important position amongst their homes. Main traffic routes, however, do not afford good



FIG. 21.—Lay-out of Llay Village near Chester. Barry Parker, Architect.

sites, as the noise arising therefrom is apt to be very disturbing. Unless, therefore, some peculiarity of the ground suggests a particularly suitable position, it will be advisable to postpone the choice of sites for places of worship until the general framework of the roads has been decided upon.



FIG. 22.—Newburn-on-Tyne, Throckley Scheme. Harvey & Wicks and Adshead & Ramsey, Associated Architects.

Open Spaces.—The position of the smaller greens and playgrounds may well be left for later decision, but it is advisable to fix upon the general location of the larger open spaces in the initial stages in order that the most suitable land may be reserved and that the roads may be planned to secure convenient access to them. In each case sites should be selected that on account of their position or character are specially suited to the purpose for which they are destined. Thus it will often happen that parts of the area would be difficult to develop for houses, but would be admirably suited for open spaces. Steep hillsides, old quarries or ravines, land with very broken surface, woods, ponds, streams, and sea-cliffs may all be utilised for natural parks possessing great charm and entailing but little expense either in first cost or in subsequent development. Level sites are required for playing-fields, and, in an undulating district, this requirement will frequently limit the choice of suitable areas ; on the other hand, in the case of generally flat sites, it will be better to use for playing-fields or allotments land which lies lower than the average, as it is more important to keep the houses dry than to secure ideal conditions for either of the foregoing purposes. If the housing site is adjacent to an industrial area it may be well at this stage to reserve a strip of land which can be planted with trees to form a screen between the houses and the works and to afford a shady resort for use in the lunch hour during the summer months. Figs. 19–23 illustrate the allocation of land for open space upon the principles described.

A Permanent Rural Belt.—Where a definite limitation of size is part of the policy of town development, the reservation of land to form a permanent rural belt will be required. This is a matter which concerns the Town planner rather than the Site planner, inasmuch as in the case of existing towns it may be necessary to carry out such a policy by degrees and as opportunity offers. The

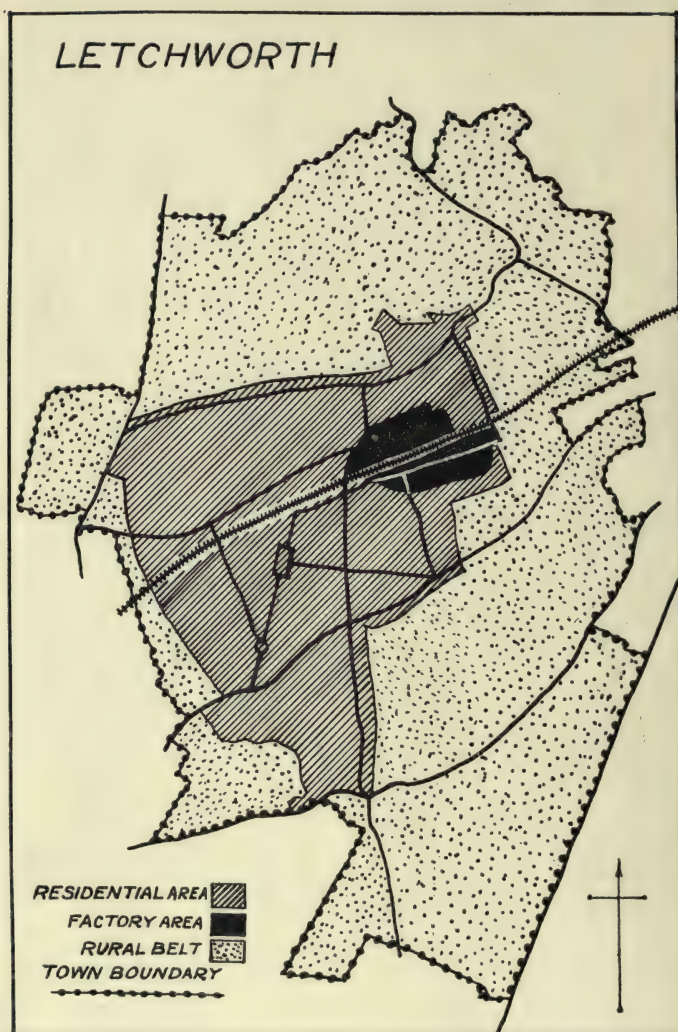


FIG. 24.—Diagrammatic plan of Letchworth, showing Agricultural Belt.

laying out of a housing site on the outskirts of a town would seem, however, to be such an excellent opportunity that it is worth while to consider for a moment the function and

desirable dimensions of such a reservation. Sir Theodore Chambers, in dealing with this subject in a chapter contributed to a book entitled *Town Theory and Practice*, discusses the four principal reasons why a rural belt round our

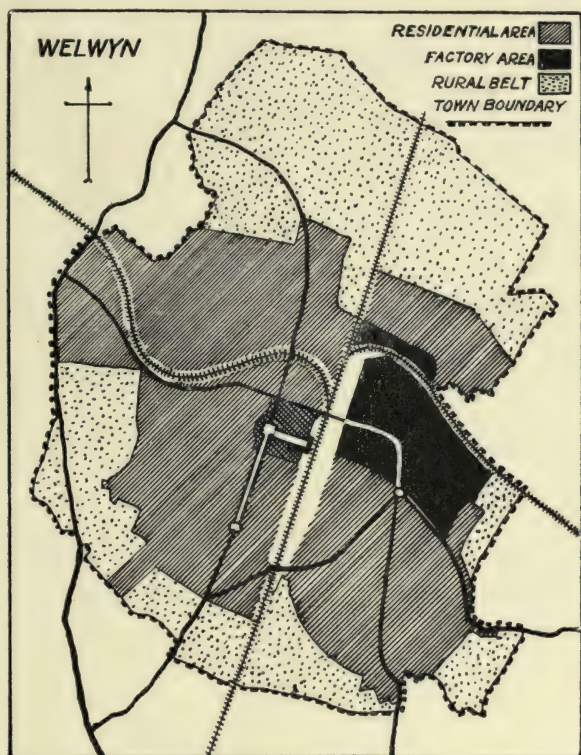


FIG. 25.—Diagrammatic plan of Welwyn, showing Agricultural Belt.

cities is urgently needed. On the social and political side, he draws attention to the fatal divorce between agricultural and urban life that has taken place as a result of the industrial development of last century, and considers it essential to break down the artificial division of the population into detached groups of country-folk and towns-people. "The segregation of the people into these two

groups," he says, "is also permanently injurious to the race, in that the cities naturally attract the most enterprising and the most gifted individuals from the rural districts through the superior advantages they offer to those with intelligence and driving power. In the towns these individuals tend to deteriorate." This tendency, he hopes, will be checked by the policy of the agricultural belt "in that the town worker will be brought into touch with rural pursuits, and the rural worker will gain the advantage of the higher standard of life and the superior social and economic conveniences of the town." The necessity for increasing the supply of home-grown food, and the advantage to the city of having its fruit, vegetables, and milk produced within its own borders and reaching the consumer with the minimum of damage and of extra expense in transit, is urged from the economic point of view. The great improvement effected in the general health of the people by preserving this close touch between town and country is also enlarged upon, and, finally, attention is directed to the value of the belt as a definite and visible limit to the area occupied by the town and to its function as a protection against the injurious effects of coalescence with urban developments in the immediate vicinity. "It is this protective function of the city's belt," to quote again from Sir Theodore Chambers, "which will mainly determine its precise area, its position and width. It must be widest where protection is most needed. It may be narrower or even omitted where there exists some natural barrier to development, such as river or marsh, mountain or moor. Along main roads or canals or avenues of approach a considerable frontage should be reserved—that is to say, the belt must be wide, since development will often run along narrow channels where transport and ease of access may encourage demand. The actual amount of land to be retained by the city undeveloped by building will be affected to some extent by financial considerations. It

must not be an amount so excessive in its relationship to the area which will be developed as to throw an undue



FIG. 26.—Diagrammatic plan of Vienna, showing Rural Belt.

burden on the resources of the city. It will therefore be inadvisable for the belt to be any larger than is actually necessary for the preservation of the town and the maintenance of the rural character of the hinterland." It will

be obvious that no precise rules can be laid down as to the size of the agricultural belt. The idea of establishing one at all in connection with modern towns is still in its infancy, and there are but few examples of its practical application. The accompanying illustrations showing the agricultural belt which has been reserved round Letchworth and Welwyn, and the famous green girdle of Vienna, will, however, indicate the provision made, in this respect, by towns of widely different character and size.

CHAPTER V

THE DEVELOPMENT PLAN : CLASSIFICATION AND DESIGN OF ROADS

CLASSIFICATION AND DETERMINATION OF WIDTHS

The Effect of Building Density upon Road Planning.—

The general adoption of twelve houses to the acre as the maximum building density allowable for the development of residential areas, has had, probably, more effect upon the design and lay-out of roads for housing sites than any other factor. For the reduction in density, primarily a matter of health and amenity, has brought into prominence two additional facts, namely : (*a*) The wastefulness of the normal system of development by means of rigidly parallel streets of uniform width and construction—particularly when applied to houses occupying more than twice the area of land than had been customary ; and (*b*) the much greater flexibility in planning rendered possible by the smaller number of houses to the acre. Where a large number of houses to the acre has to be accommodated, the development of the land by parallel roads is practically unavoidable and the differentiation between main roads and minor roads is, accordingly, very difficult. For this reason, and also because of the greater intensity of use of all the roads resulting from the increased number of houses, a uniform type of road with wide carriageway constructed to support the heaviest traffic must almost of necessity be employed. The disadvantages of this method are obvious. The standard width (which in practice naturally became the maximum) has proved insufficient for carrying a large

volume of traffic, and its adoption has entailed constant and expensive widening of streets which have subsequently become main routes. On the other hand, the provisions as to width and construction are excessive for roads which merely give access to houses, and add unnecessarily to the cost of development. With the more open system of development these difficulties are avoided. The greater flexibility in planning permitted by the density of twelve houses to the acre, by enabling a departure to be made from the parallelism of the old method, has made it possible not only to lay out the roads in conformity with the configuration of the ground, but, what is even more important, to adopt a system in which both the location of the roads and the widths of carriageways and footways are determined by the particular function they are intended to serve.

Classification of Roads.—In such a system the roads may conveniently be classified under the following heads :

1. Arterial or through-traffic roads.
2. Secondary roads forming important connections between local centres and linking up the arterial roads.
3. Residential roads, the primary function of which is to give access to the houses.
4. Boulevards or parkways.

Arterial Roads.—Arterial roads should be designed to secure adequate width, direct routes, and easy gradients. Their function as through-traffic roads should be so emphasised by the overall width and the arrangement of the carriageway, footways, and margins that, at a junction or fork, no one can mistake the main route. The topography of the site will influence the precise course which is finally laid down for roads of this class, but subject to the undesirability of excessively long vistas—referred to in the last chapter—directness will be one of the most important

considerations. At all changes of direction, and where the general character of the road is sinuous, easy curves should be used in order to check the flow of traffic as little as possible. Awkward junctions should be avoided, and the number of cross roads or roads leading into the main road should be reduced as far as practicable. This has been made an especial point in the Liverpool housing schemes, which are intersected by Queen's Drive, an important ring road with a reserved track for fast trams in the centre of it. Reference to the illustrations in Figs. 12, 13, and 14, will show the method of collecting up the subsidiary roads and leading them into the main road at wide intervals, which has been adopted to secure this end.

Total Width.—The total width of an arterial road is a matter which depends upon its relative importance and the nature and volume of the traffic it is likely to carry. No hard and fast rules can be laid down as to the best width to allow, but it is wise to reserve sufficient space to permit of future enlargement of the carriageway if this becomes necessary. Enormous expense for subsequent widening will thus be avoided, for the price of the land in the first instance will be small, while the purchase of the developed frontage is always a costly proceeding. The distance between fences, therefore, should be ample even though a comparatively narrow carriageway will meet immediate requirements. At the same time there is nothing gained by making excessive provision, and the circumstances may dictate a width falling anywhere between such wide limits as from 60 to 120 feet. In deciding upon the width it should be remembered that the dimensions of the arterial roads should be proportionate not to the size of the housing scheme, but to the requirements of through traffic.

Width of Carriageway.—The width of carriageway is determined by the number of lines of traffic to be accommodated. Allowing 8 feet for each line of vehicles, it is

probable that 24 feet, or provision for three lines of traffic, will be sufficient in the first instance, though this will depend, of course, upon the individual circumstances.

Provision for Trams.—If the road is to carry a service of trams it will be necessary to consider which is the best position for the track to occupy. The most usual position, hitherto, has been in the centre of the ordinary carriageway, and, if this plan is adopted, a distance of at least 36 feet will be required between kerbs. The inconvenience of such an arrangement is, however, generally recognised, and where—as in laying out a new road—it is possible to provide a separate track for trams, either in the middle of the road or at the sides, it is advisable to do so. By this method inconvenience to the general traffic is very much lessened, while the speed of the trams can be increased without danger; the cost of laying the track is also greatly reduced, as the rails can be laid on sleepers in grass or ballast instead of upon heavy concrete foundations with granite pitched surface. A central track between an avenue of trees will occupy a strip about 40 feet wide, and ultimately there will be required on each side of it a carriageway at least 16 feet wide, which, with footways 8 feet wide and margins 10 feet wide, makes a total width of 108 feet. It may not be necessary to construct more than one carriageway in the first instance, and until the full accommodation is required the unused portion can be laid down with grass to form an attractive park strip. Suitable means of access to the houses fronting the park strip will, of course, have to be provided, and for this reason it will be necessary to make up the footways on both sides of the road.

To meet the objection that with a central tram track passengers are compelled to cross the stream of traffic in order to reach the trams or gain the footpath, an alternative arrangement in which the tramways are placed upon the margin at each side of a central carriageway is sometimes adopted. The disadvantages of this method are that

persons alighting from vehicles drawn up at the kerb have to cross the tram lines in order to reach the footway, and also that the noise and disturbance inevitably associated with a fast tram service are brought in closer proximity both to the pedestrians using the road and to the houses fronting on to it. The latter defect, indeed, is so serious, while the supposed advantages are so slight that, of the two arrangements, that with the track in the centre is much to be preferred. It is by no means certain, however, that trams are the best form of road transport. The track is very costly to construct; overhead wires are unsightly, and conduits much too expensive; while the lack of flexibility inherent in the system is a source of obstruction to general traffic. It would seem, indeed, that there is no service performed by trams at the present time which could not be done better and as cheaply by motor omnibuses. It is said that the future of tramways is in their development as light railways, with regular stopping-places at longish intervals, and the opportunity of attaining a much greater speed. In large towns, where the distances are considerable, there is much to be said for this view. But it is quite clear that tramways of such a type can have no place in the busy streets of the central area of the town, while it is very doubtful whether they are suitably accommodated upon the streets at all. If, therefore, they develop as light railways, they will have to conform to the conditions which govern light railways and adopt a separate track, with proper provision for crossing roads without danger to ordinary traffic.

Gradient.—The gradient of through-traffic roads should be kept as low as possible, and a slope of 1 in 20 should be regarded as the maximum allowable under ordinary circumstances. The contours of the ground may, however, render it impossible to keep within this limit without incurring undue expense in cutting and filling, or involving too great a detour from the direct line. In such cases it

will be necessary to adopt a compromise which satisfies the opposing conditions in the ratio of their importance.

Standardisation Undesirable.—It will be seen that considerable latitude is possible in determining the width and allocation of space in Arterial Roads. It is inevitable that this should be so, for we have experienced the disastrous results of adopting a standard width, and it would be folly to repeat the mistake. To secure a satisfactory result, which is neither too ambitious nor too parochial, it is necessary to study the local circumstances in each case, and, while making ample provision for future needs, to avoid overburdening a district with a road wider than is ever likely to be required. Fig. 27 shows the widths and cross-sections which have been adopted for arterial roads passing through various housing schemes.

Secondary Roads.—Next in order of importance come the Secondary Roads, which form links between the Arterial Roads and connect the local centres. These are the principal roads of the actual housing development, and their location and design will be influenced more by the needs of the scheme than by those of through traffic. They will form the channels through which the local traffic will circulate, and they must accordingly be located so as to afford direct communication between the various centres, and to open up the site in a convenient way. The requirements of fast traffic are not in this case so important a consideration, and more attention can be paid, in determining their course, to the lie of the land and the suitable development of the area. Secondary streets must, however, be important in appearance and sufficiently direct to divert general traffic from the residential roads. Hence it is desirable to make them fairly wide. The width will here be governed almost entirely by the size of the scheme, but in normal circumstances it will range between 40 and 60 feet overall, with a carriageway 16 or 24 feet wide and two footways each 8 feet wide. A gradient of not more than 1 in 15

ARTERIAL ROADS

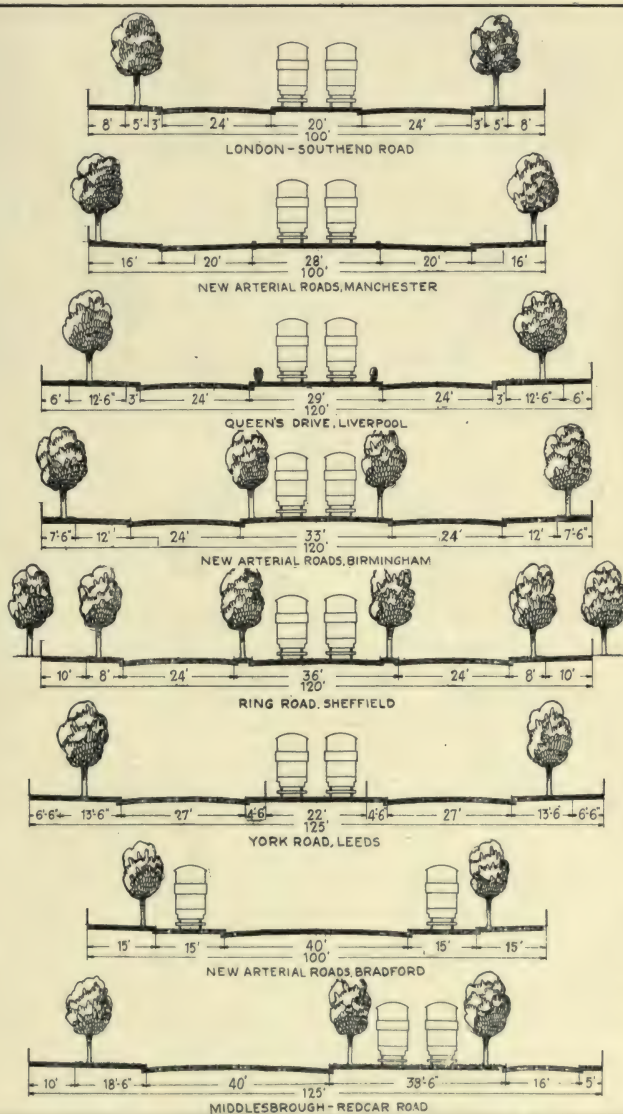


FIG. 27.—Diagram illustrating the Cross-sections adopted for Arterial Roads at present under construction.

should be aimed at, though in very hilly districts it may not always be possible to adhere strictly to this limit. Cross-sections of secondary streets are illustrated in Fig. 28.

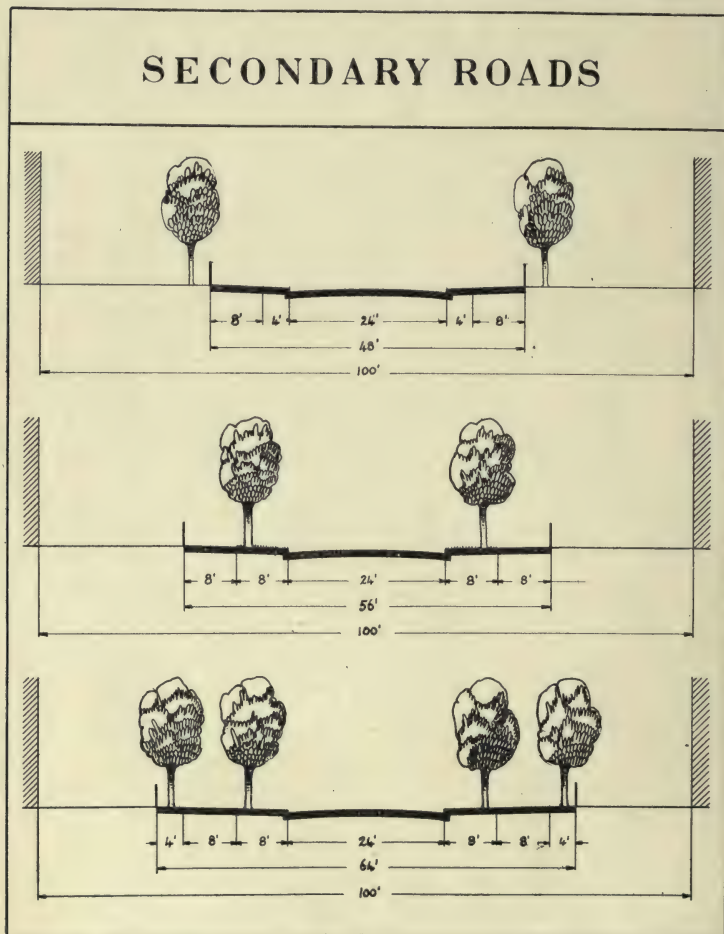


FIG. 28.—Suggested Cross-sections for Secondary Roads in Housing Schemes.

Residential Roads.—The principal function of Residential Roads is to provide access to the houses. If the primary and secondary streets have been arranged properly, there

will be no inducement for through traffic to make use of these minor roads, a circumstance which, besides maintaining the quietness and privacy desirable in residential neighbourhoods, affords a greater degree of freedom in planning and renders it possible to employ narrower carriageways and lighter construction than would otherwise be permissible.

Major Residential Roads.—For the more important roads in this category, a carriageway at least 16 feet in width and two footpaths each 6 feet wide should be provided. Grass or gravel margins should also be included, both on account of their value as decorative features and also to allow for possible future widening. The total width required between fences will vary, according to the treatment adopted, from about 40 to 50 feet. Typical cross-sections are illustrated in Fig. 29.

Minor Residential Roads.—Short residential roads, serving comparatively few houses, will not usually require more than a 13-foot carriageway, as this allows two ordinary vehicles to pass when travelling slowly, and fast traffic is not to be anticipated. The footpaths, also, can be made rather narrower or, under certain conditions, even omitted altogether. Where they are provided, a paved width of 4 ft. 6 in. is generally sufficient, and with suitable margins the total width will range between, say, 25 and 36 feet. Fig. 29 shows various methods of treatment. It is difficult to prescribe an exact limit of length for such roads, since the circumstances which determine this will vary in almost every case. But by way of guidance it is suggested that under normal conditions the length should not exceed about 450 feet, though this distance might be extended without objection where the road forms merely a loop or crescent, or has houses only on one side.

Drives.—For access to groups of houses situated in short culs-de-sac, round quadrangles or small greens, carriageways 8 feet wide will usually be adequate. The

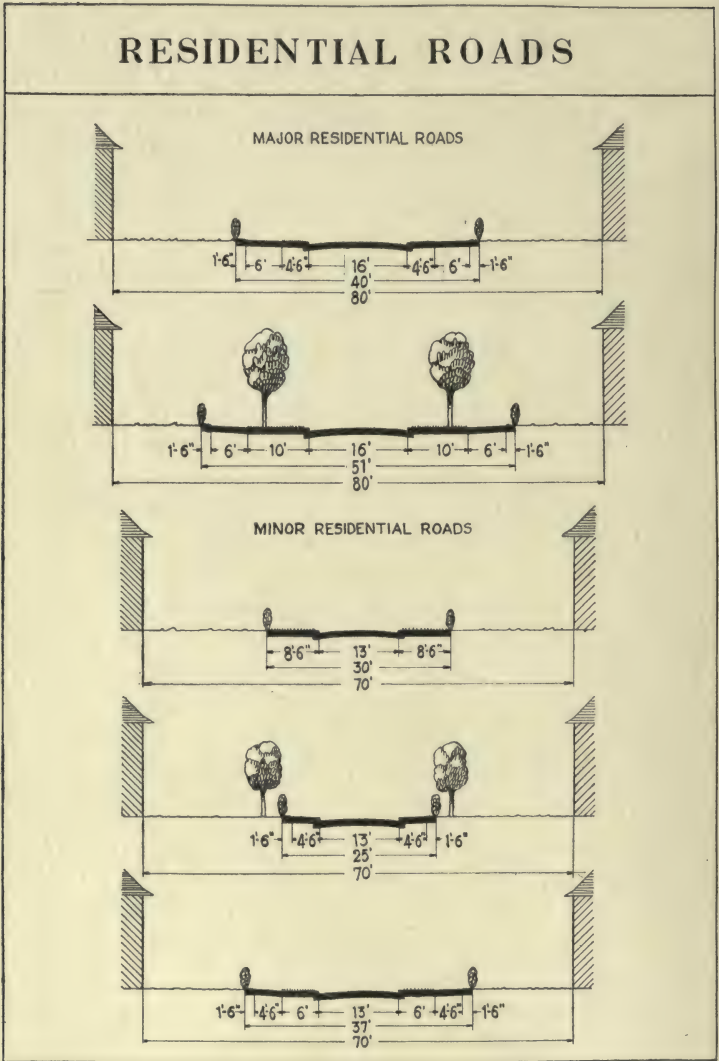


FIG. 29.—Typical Cross-sections of Residential Roads.

amount of vehicular traffic in such cases will be strictly limited, and there will be no need to provide separate footways. It is desirable, however, to allow margins of reasonable width, both in order to secure the safety of pedestrians during the passage of carts, and to preserve the character of a private carriage-drive which is the motif of the design.

Turning Spaces.—Turning spaces are required in connection with all carriageways having a width of 16 feet or less; and, in the absence of cross roads which fulfil this

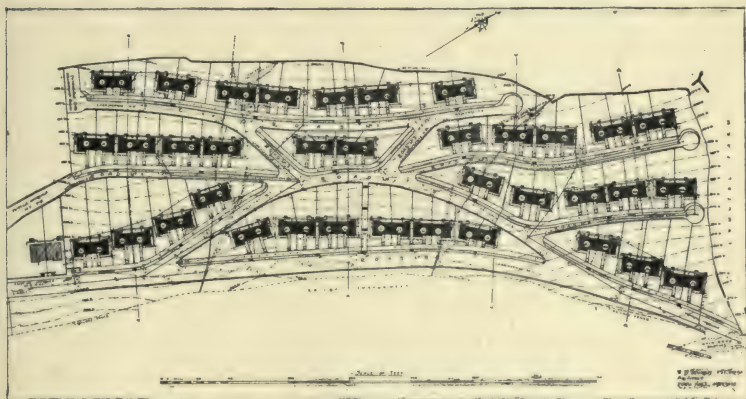


FIG. 30.—Aberdare, Cwmneol Housing Scheme, showing use of single-sided roads on steep slope. W. D. Jenkins, Architect.

function, they should be placed at intervals not exceeding 150 yards and be given a diameter of about 30 feet.

Gradients.—The gradients of residential roads should be kept as low as circumstances permit, both for the convenience of traffic and also to avoid the increased cost of road construction and house building upon steep slopes. But although due weight should be given to these considerations, it may be pointed out that the requirements of traffic are not, in this case, of primary importance, and a gradient of 1 in 10 will be found a workable limit to adopt.

level will be the most satisfactory arrangement (see B, Fig. 32), while under certain circumstances the duplication of the carriageway at different levels may be desirable. Such a

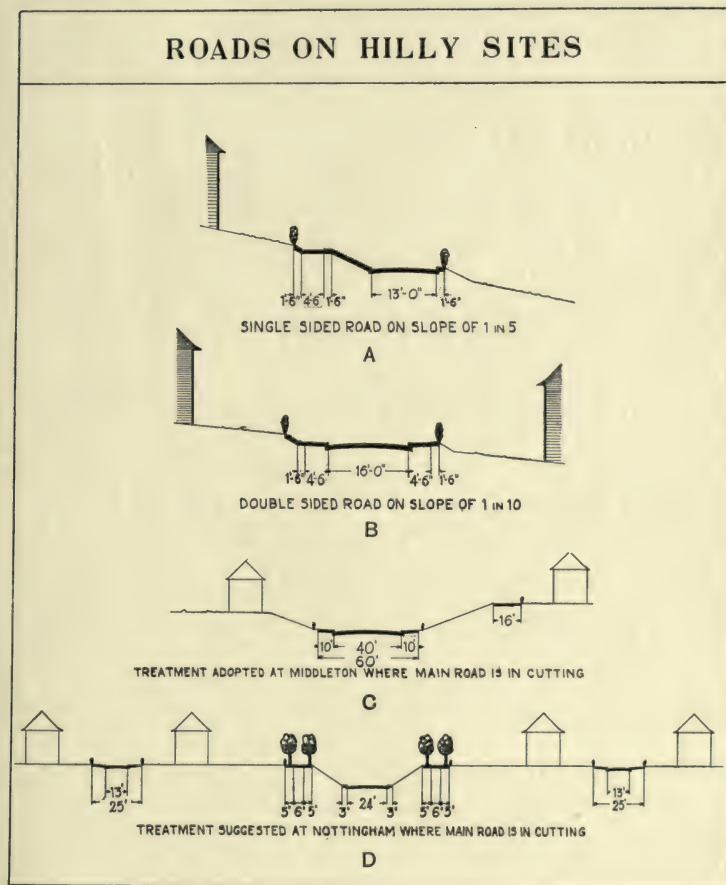


FIG. 32.—Cross-sections of Residential Roads adapted for use on hilly sites.

case does not frequently arise in connection with housing schemes, because the cost would usually be prohibitive; but where, as at Middleton (C, Fig. 32), for example, the main road is in deep cutting, a subsidiary carriageway at a

higher level is the only practicable means of making use of the frontage. The treatment suggested in a similar case at Nottingham (D, Fig. 32), in which the subsidiary road is placed farther back, and serves to provide frontage for a double row of houses, is, however, more economical though it does not achieve precisely the same result.

Boulevards and Parkways.—*Character.*—Boulevards and parkways constitute a distinct class of road. Originally meaning a promenade constructed upon the site of demolished city fortifications, the term boulevard has now a much wider significance, and is wrongly used to indicate any wide road planted with trees. The word properly implies the idea of walking or riding for pleasure, and this connotation, in fact, is the key to the design and placing of boulevards. They are, as it were, attenuated parks, bringing the real parks into closer relationship with the town. Hence it is important that they should be co-ordinated with the park system, the central *place*, or any other important centre of public interest.

Width and Treatment.—The width allocated to boulevards will vary with the size of the scheme and its relationship to the town, but a generous amount of space should be provided for the park-like features. A great variety of treatment, both as to width and arrangement, is possible. In many cases arterial ring roads have been designed as boulevards, frequently with tramways, as instanced by the Queen's Drive, Liverpool. Other examples are planned definitely as non-traffic roads, as, for example, those at Dormanstown and Lemington-on-Tyne of the encircling type, and those at Swanpool and Glasgow (Shettleston and Tollcross), where they are intended to form direct connections between public buildings and parks. In the Glasgow plan the canalised stream would form a feature unusual in this country, but of great charm if properly cared for. Greater use might be made of flowering shrubs and trees for

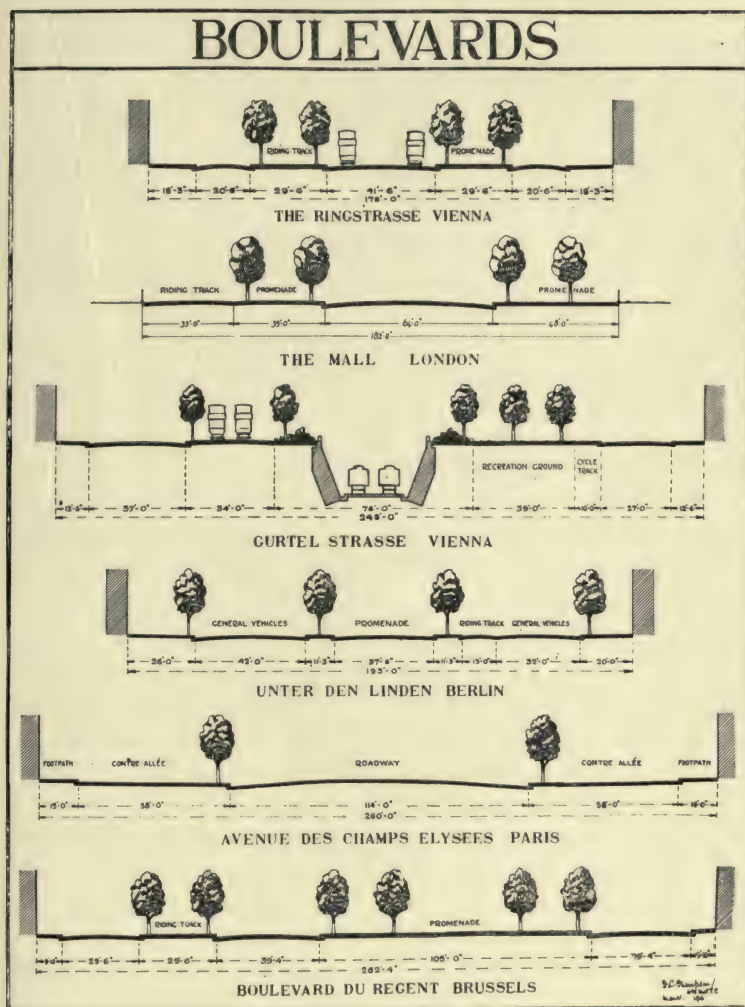


FIG. 33.—Cross-sections of Boulevards in various cities.

decorating these parkways, and in rare cases flower borders and rose beds have proved successful. But, without any elaboration of this kind, a shady and reposeful promenade

can be achieved by a perfectly simple combination of trees and grass. Some examples of different methods of treating boulevards are illustrated in Fig. 33.

ROAD CONSTRUCTION

Construction determined by Character of Roads.—

Except in so far as it is related to estate development, the subject of road construction does not fall within the scope of these pages. But since the expenditure upon roads is one of the principal items in the cost of development, and the chief object of the classification we have just considered is to furnish a legitimate means of reducing that expenditure to a minimum, it will be desirable to consider briefly in what respects the results of more scientific planning justify a departure from the previously accepted standards of municipal practice. It must be recognised at once, that nothing will be gained by cutting down the first cost of roads at the expense of a proportionately greater increase in the cost of maintenance. For this reason, main highways for general traffic should be of substantial construction in view of the wear and tear to which they are likely to be subjected. In the case, however, of roads upon which heavy traffic is not to be anticipated—and it is possible by means of proper planning to determine the character of a road with some accuracy—certain economies can be effected without detrimentally affecting the cost of upkeep.

Kerbs and Channels.—The use of heavy granite kerbs, for example, while necessary in the case of city streets, is not essential in residential roads, where the traffic is not only much less in volume but is also of a completely different character. Much lighter construction—using Pennant limestone or concrete—has proved perfectly satisfactory under these conditions, and not infrequently it has been found that in the smaller roads a grass margin with, perhaps, an occasional stone to protect the edge, is all that is

required. Channels, in the same way, need some reconsideration. Upon steep gradients, where there is considerable scour, the gutters must be formed of some material which will adequately protect the road surface from abrasion. But under normal circumstances the use of 15 by 4 inch granite slabs, or alternatively from 4 to 6 rows of granite setts, which is frequently required by Municipal Authorities, is an expense which cannot be justified in housing development. Light channels of blue brick, scoria block, or concrete, will usually be necessary where the road surface is composed of water-bound macadam. But where the surface consists of tar-macadam, the channel

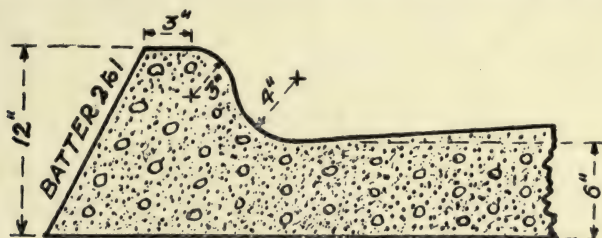


FIG. 34.—Combined Kerb and Channel in Concrete.

can be formed of the same material, though if kerbs are used it is advisable to lay one row of setts or similar blocks to protect the latter from damage during rolling operations. Concrete kerbs and gutters are used extensively in America, and would appear to be quite satisfactory ; the combined form, illustrated in Fig. 34, is particularly neat, and can be cast either in separate units for use with any type of carriageway, or as an integral part of a concrete road.

Carriageways.—Foundations.—Whatever material may be employed for the surfacing of carriageways, it is essential that the foundation or hardcore should be solidly constructed, as the strength of the road depends upon the stability of its foundations. No economy should be practised, therefore, which in any way endangers the

permanence of the carriageway in this respect ; for although the wearing surface will require renewal from time to time, it will wear better and last longer if the foundation has been properly made, while the cost of re-surfacing will be only a fraction of the expenditure necessary to remake the entire road. The surface of the ground upon the site of the carriageway should be prepared by the removal of the turf or other perishable matter, by draining the subsoil where this is necessary, and by consolidating the formation surface to the required camber with a heavy roller. On a clay subsoil, or where the ground is otherwise soft, a layer of well-burnt furnace or destructor clinker should be spread and rolled until the surface is rendered sufficiently firm. The materials composing the hardcore may consist of quarry refuse, slag, hard broken bricks, well-burnt destructor clinker, or similar suitable material, generally not exceeding half-brick size. These should be spread uniformly over the formation surface and rolled until a hard compact layer of the requisite thickness is obtained, 9 inches being usually sufficient. The practice of hand packing, formerly considered to be essential, is no longer regarded as the best method, owing to the great expense of the labour involved, and the tendency of the larger stones used in this process to work through the crust.

Surface.—The surface may be finished either with a coating of water-bound macadam, gravel, or flints from 4 to 6 inches thick ; tar-macadam from 3 to 4½ inches thick ; or the entire road may be constructed of concrete, suitably reinforced and of an average thickness of 6 inches. Local conditions will exert considerable influence upon the type of surface which it is most economical to adopt. But generally speaking the durability of water-bound macadam is so much inferior to that of tar-macadam, that its use for any but the smaller residential roads is not justifiable on account of the relatively high cost of maintenance. Coating with tar will undoubtedly assist in preserving the

surface, but the process has to be repeated at frequent intervals and the result is never equal to that obtained by the use of tar-macadam in the first instance. Concrete roads are not yet in sufficiently common use for an accurate estimate to be made of their cost and durability in comparison with other types of construction. It is claimed, on their behalf, that as the depth of excavation and the amount of rolling required are both diminished, the initial cost is not materially greater than that of a road constructed with a hardcore foundation and tar-macadam surface ; while that from the point of view of appearance, smoothness, durability, and low maintenance charges, the advantages of concrete are superior. They have this drawback, however, that they cannot readily be opened up for access to sewers, water-mains, etc. ; this is perhaps an additional reason why such service pipes should be laid, as far as possible, under the footways or margins and not under the carriageway.

Footpaths.—Footpaths should generally be placed next to the boundary between the road and the front gardens, so that grass or other margins, included in the total width, shall occupy a position immediately adjoining the kerb. In order that foot passengers may be able to enjoy the use of its full width, the paved portion of the path should be kept at least 18 inches from the centre line of the fence or hedge, this space being treated with gravel or grass, according to the character of the road. The most serviceable pavement is undoubtedly obtained by the use of natural or artificial stone flags. These are neat and pleasant in appearance, and have the great advantage that they are easily lifted and relaid when this is necessary for attention to the mains which are usually situated under the footpaths. Except in those districts where it is quarried, natural stone is apt to be too expensive for general use, but the artificial variety which is now made in large quantities from refuse destructor clinker, is not costly,

and under the improved progress of manufacture is extremely durable. Both concrete laid in situ and tarpaving provide good surfaces, and the latter is rather lower in first cost, though not, of course, so durable, as the materials previously mentioned. But in common with all pavements laid in large slabs, they are liable to crack through uneven settlement or changes of temperature, and they never completely recover from the havoc occasioned by the periodical repairs or renewals to gas and water mains. Brick paving is frequently used in localities where suitable material is manufactured ; it tends, however, to become very uneven in wear, and is difficult to keep clean.

Margins.—It is customary to include within the boundaries of the street a greater width than is required for the carriageway and footways alone. This extra space serves a double purpose. It provides, on the one hand, for the subsequent widening of the carriageway if this should become necessary, while, on the other hand, it permits the introduction of decorative features, such as trees and grass. It is usually divided into two margins placed next the kerb on either side of the carriageway, and this is generally the best arrangement ; there are occasions, however, when the cross-section of the street is definitely asymmetrical (as, for example, with a street running parallel to the contours on a steep hillside), and in such cases the whole of the space may be used for a single margin on one side of the road. The treatment of these margins requires careful consideration. When properly cared for, grass verges contribute much to the appearance of a street, but if they are allowed to become ragged and unkempt, or to be trampled out of existence, they are little better than an eyesore. Unless, therefore, proper arrangements can be made for its being reasonably well looked after, and sufficient width can be reserved to prevent the turf being worn bare, grass should not be employed. Opinions differ as to the minimum width

which can be regarded as effective from this point of view, but it may safely be assumed that nothing less than 6 feet is likely to be of use. Where it is not possible to provide so great a space, or grass is for other reasons unsuitable, a low, wide, well-clipped hedge or a small shrubbery will often introduce the desired decorative note. In other cases gravel can be used. This material is easily kept in good order, and is especially appropriate for the promenades in parkways and for use under shady avenues where grass does not thrive.

TREE PLANTING

General Observations.—No treatment of the classification and design of roads can be considered complete without some reference to the matter of tree planting. Trees have a very definite place in the decoration of towns, and there is no doubt that we have suffered in the past by reason of their exclusion from so many of our streets; nevertheless, we must beware lest over-enthusiasm to rectify this mistake leads to their indiscriminate use. For if every road is equally embellished in this respect, any character or individuality it might derive from such treatment is to a large extent lost, and it becomes merely a monotonous repetition of its neighbour. Hence the use of trees should be reserved for those occasions when they constitute an essential element in the design.

In Main Roads and Boulevards.—A splendid avenue adds greatly to the charm and dignity of a broad thoroughfare, and as it also provides shade and a certain degree of protection from the dust and noise of passing traffic, it is a feature which may very suitably form part of the design of main roads and boulevards. In such a position the natural growth of forest trees will not be out of scale, though in the more formal atmosphere which should pervade the central area of a town, the employment of a species

which lends itself to pleaching is frequently to be recommended, since such treatment is more in accord with the architectural quality of the buildings.

In Residential Roads.—The more important residential roads may also appropriately be planted; but in order that they should not compete in importance with the main arteries or boulevards, smaller and more decorative trees—flowering varieties, for example—should be used. In the minor residential streets, where the houses will usually be somewhat closer together than elsewhere, it is better to confine the use of trees to the emphasis of some special grouping of houses upon which it may be desirable to focus attention. It must not be inferred that these streets should necessarily be devoid of all other foliage, for provided it is kept subordinate to the principal group, some additional greenery is often very pleasing. In such circumstances, however, it is better to plant whatever may be chosen, not in the road, but in the front gardens of the houses; something that does not grow too large—flowering or evergreen shrubs, for example, or a well-grown hedge—will therefore best serve the purpose.

Result dependent on choice of suitable Varieties.—The chance intrusion of stray trees into a street picture is frequently most effective, but conscious attempts to produce such accidents are rarely satisfactory, and it may be stated as a principle that bold and judicious massing is a much more certain way of achieving success. But, however well they may be arranged, the final result will depend upon the vigour and beauty of the trees themselves. It is therefore essential, not only to choose the kinds of trees that are suitable for the position and treatment intended, but also to choose those varieties that will grow well under the conditions of soil and atmosphere with which they will have to contend.

CHAPTER VI

THE DEVELOPMENT PLAN : THE ARRANGEMENT OF THE ROADS

IN order that the objects of the classification of roads advocated in the last chapter may be achieved in actual practice, it is necessary that the roads should be so disposed upon the Site as to maintain the character assigned to each. This result cannot be attained by haphazard methods, but only by careful arrangement and co-ordination. It is therefore essential to devote great care to the planning of the scheme of roads.

Types of Lay-out.—*The Rectangular Form.*—Several systems, based upon various theoretical solutions of the problem, have been put forward from time to time. In America the rectangular or gridiron form of street planning has, until recently, been almost universal. On a level site it has the advantage of simplicity and of dividing the area into convenient plots for building. But from the point of view of traffic it is open to serious objection. There is no means of regulating the use of streets, as each one is on a par with every other, and there is no provision for radial communications. A further disadvantage—inherent in the system—is, that it is entirely unsuitable for any but flat or uniformly sloping sites. It is incapable of accommodating itself to varying ground levels, and when used under these conditions it involves much unnecessary expense in road making, sewerage, and building. Streets laid out on this plan are usually excessively monotonous and inconvenient. Even when an attempt is made to

remedy the defective traffic provisions by the introduction of diagonal roads, the result is far from happy, as the awkward shape of the sites at the intersections of these roads with the square network of the ordinary streets makes them unsatisfactory either for buildings or open spaces.

The Spider's Web Plan.—Many of the objections to the gridiron arrangement are met by the system which is based upon the spider's web. This consists essentially of a series of streets radiating from a centre and connected up by another series arranged more or less in concentric circles. This arrangement is well adapted for the convenience of traffic, while it is possible to secure that all sites are of a reasonably suitable shape and size for economical building. Unlike the rectangular system, the advantages of which depend upon strict adherence to the theoretical form, the spider's web is readily adaptable to the exigencies of the site, and is not less effective if local requirements necessitate even considerable divergence from the ideal figure. It is in many respects the natural way in which a town would develop, and is, in fact, the way in which a great many towns have developed. As the market and social rendez-vous of the surrounding country, the town would naturally be the focal point of the roads leading from outlying villages, while as its own growth would be from the centre outwards—always with a strong magnetic attraction to the centre—the radial system would be extremely convenient, and with the obvious development of the sectors between the radial roads by means of cross roads, an arrangement very similar to that of a spider's web would come into being. Clearly, however, it is a system that requires a centre of some importance to justify its use, for without such it would cease to be convenient, as all the roads would lead to a place where nobody wanted to go. Hence, while it is eminently suitable for the framework of main roads for a town, its application to the laying out of housing sites

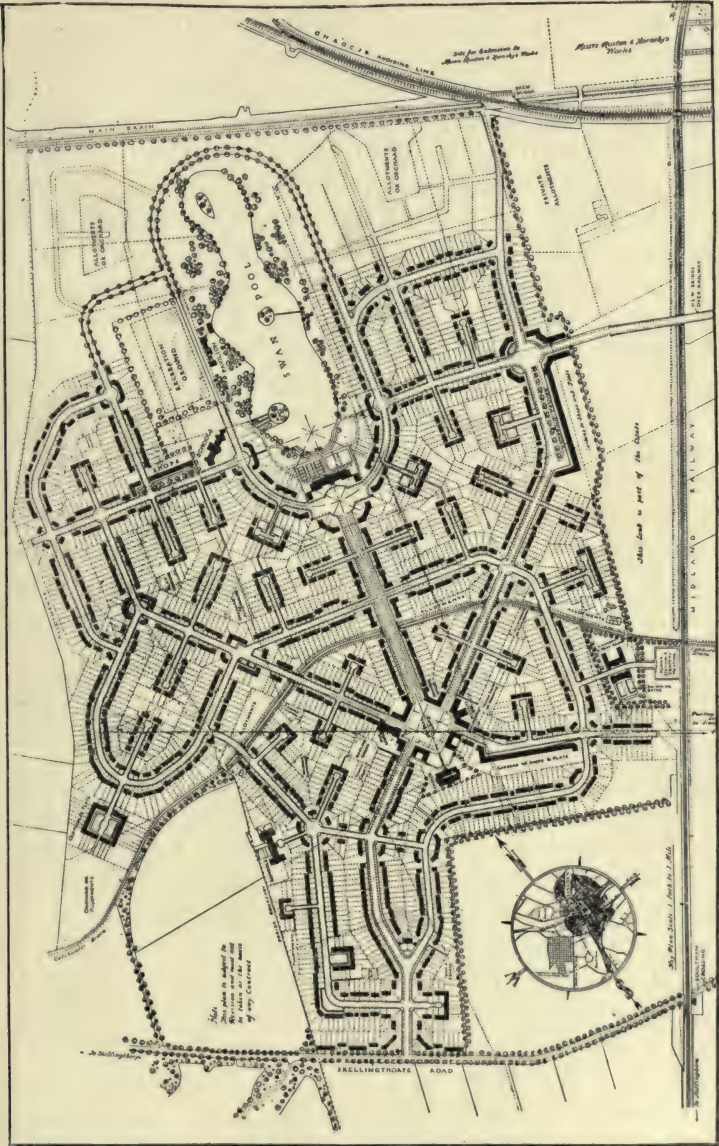


FIG. 35.—Lay-out plan of Swanpool Garden Village near Lincoln.
Thompson, Hennel & James, Architects.

requires careful consideration, and should not be adopted without good reasons.

The Geometrical Arrangement.—Another method of planning which has enjoyed a great vogue is the geometrical. The predominating feature of this style is the formal arrangement of the roads in a symmetrical pattern. It offers excellent opportunities for architectural treatment in the formal manner, and is very suitable where this is appropriate; but where the architecture—as in the majority of housing schemes—is informal, it is not altogether satisfactory. Moreover, there are few positions whence it is possible to recognise the symmetry of a plan save from an aeroplane, and it is not therefore worth while straining too much after an effect appreciable only on paper. There is a further objection to the general use of geometrical planning in that it is rarely completely adapted to the configuration of the ground, and consequently involves additional expenditure upon roads, sewers, and houses that is in no way justified by the resulting appearance.

The Contoured Method.—The exact opposite of formal planning is the practice, now increasingly followed, of laying out the roads to conform as nearly as possible to the contours of the land. By this method individual character is imparted to the scheme by the emphasis of the individual characteristics of the site. It is peculiarly suitable for the development of residential areas where directness in the minor roads is not only not essential, but to some extent undesirable. The careful adaptation of the plan to the ground levels, results, also, in considerable economy both in the cost of constructing roads and sewers and in the foundations of houses. For the sake of convenience in maintenance, it is the almost universal practice to lay sewers along the roads, so that if the roads are laid out to follow, and fit in with, the natural drainage lines, the difficulties and expense of sewerage are reduced to a



FIG. 36.—Jordans Village. Fred. Rowntree & Sons, Architects.

minimum. In road making also, the heavy cost of excavation and filling incurred in the case of roads located without proper reference to the contours of the site, is almost entirely avoided, while it will be evident that the best building frontage is obtainable upon roads which closely follow the natural level of the ground.

It must not be inferred that the successful application of this method involves following the contours with slavish accuracy. Apart from the monotony to which this might give rise, it is undesirable for practical reasons. It would, for example, unnecessarily increase the difficulties of dealing with the surface-water drainage, while the primary necessity for providing convenient access about the site, will involve the use of roads up and down hill even if they were not otherwise desirable. Thus within wide limits considerable freedom of planning can be exercised, and the great merit of the contour method lies in its complete adaptability to the site.

Form of Lay-out determined by Local Conditions.—Every site, however, has its own peculiar problems, which cannot be solved by the application of a ready-made plan, and in every large scheme the difference between the functions of the various parts should be reflected in the type of planning adopted. Thus the formality and symmetry which should characterise the arrangement of the streets in the vicinity of the public centres, would be out of place in the lay-out of the minor residential roads, and *vice versa*. But too often, enthusiasm for a particular school of planning, generated either by the personality of its founder or by the reaction from some other school, has led to the indiscriminate use of one system. In America, for example, the gridiron plan has been applied with ruthless persistence irrespective of its fitness. In Germany, on the other hand, the reaction from the severely formal methods of the Haussmann period has produced an artificial cult of the picturesque that is equally unsuitable for uni-

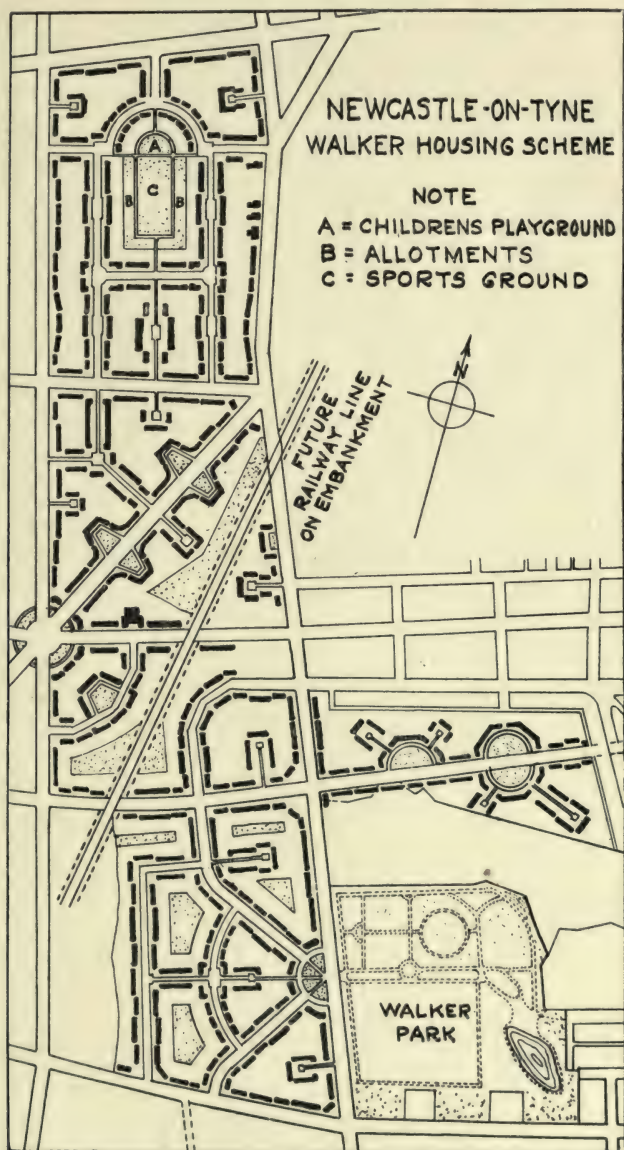


FIG. 37.—Lay-out plan for Walker Estate, Newcastle-on-Tyne.
Longstreth Thompson, R. Dann & S. P. Taylor, Architects.

versal application. The adoption of one system to the exclusion of all others is, in fact, absurd. Each has certain merits and is applicable to certain conditions, and the only reasonable course to pursue is to combine the appropriate elements of the different methods and adapt them to the circumstances of each case.

Essential Features of Road System.—In designing the lay-out plan of the roads, therefore, the matter should be approached with an open mind, and questions of purpose, economy, and convenience, rather than a predilection for any particular pattern, should determine the lines to be followed. There should be a good reason for the placing of each road, and its cost should be justifiable either as a thoroughfare for traffic, a necessary means of convenient access about the site, or as economical building frontage for houses. As each site is an individual problem it is difficult to enunciate principles of planning that are generally applicable. But whatever may be the conditions, it is essential to arrange the main or arterial roads to secure adequate width, direct routes, and easy gradients; the secondary roads to afford convenient access about the site, link up important centres, and divide the area into blocks of suitable size and shape for development by the residential roads, which should be planned to provide attractive approaches to the buildings situated upon their frontage.

In the case of hilly sites the configuration of the ground will usually be the determining factor in the arrangement of the roads, and even where the land is approximately level there will often be some physical characteristic which will influence the general scheme of the lay-out. Thus the old swan pool largely regulates the plan of the garden village near Lincoln, to which it lends its name (see Fig. 35). Watercourses exert a decided influence, and woods and parks sometimes suggest the lines of development, as at Jordans (Fig. 36), the Walker estate at Newcastle

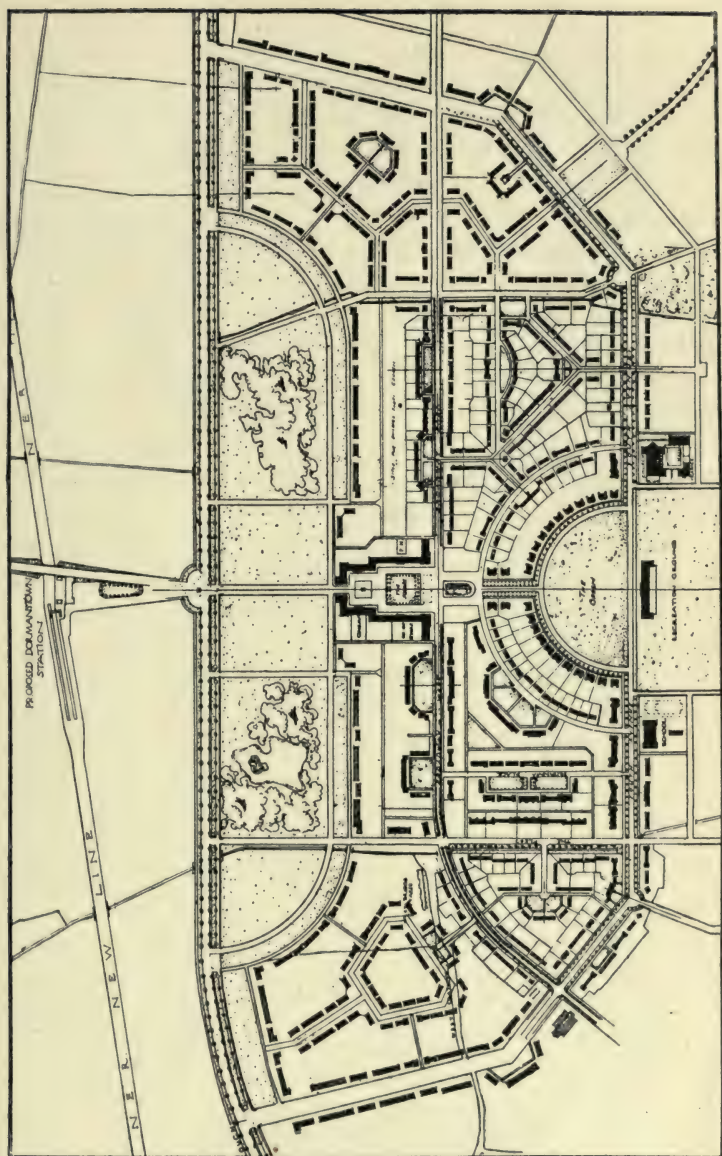


FIG. 38.—Lay-out plan of Dormanstown near Redcar.
 Adshead & Ramsey and Patrick Abercrombie, Associated Architects.

(Fig. 37), and the Walton-Clubmoor site at Liverpool (Fig. 14). While existing main roads and railways are frequently controlling factors, as in the case of the Liverpool schemes illustrated in Figs. 12, 13, and 14.

In the absence of any special reason for introducing informal lines, it is usually better on a flat site to keep to some such simple arrangement of straight lines and regular curves as is illustrated by Fig. 38. Mere pattern making, however, should be avoided by bearing constantly in mind that the object in view is to arrange the roads in such a manner as to afford convenient access about the site and also to develop the land for building purposes in the most economical manner. When the secondary roads have been laid down so as to divide up the estate into approximately equal portions, it becomes necessary to develop these portions by subsidiary roads in order to provide frontage for the requisite number of houses.

Economy in Road Frontage.—*Continuous Building.*—

Since the cost of development will depend upon the reduction of the average road frontage per house to the minimum compatible with a proper allowance for the actual width of the house itself, it will be desirable to consider, in some detail, the circumstances which affect the achievement of this object. These are illustrated very clearly in Fig. 40. Diagram A shows the simplest case in which all the houses are accommodated upon one straight road of indefinite length. The houses are in two continuous rows, and the road frontage occupied by each house is therefore the exact width of the house. (The density makes no difference whatever, as the plots can be as long or as short as desired without affecting the road frontage.) This is, of course, a purely hypothetical case, but it will make clearer the effect of the limiting factors which are encountered in practice.

Gaps between Houses.—The effect of splitting up the long terraces into smaller blocks is shown in Diagram B.

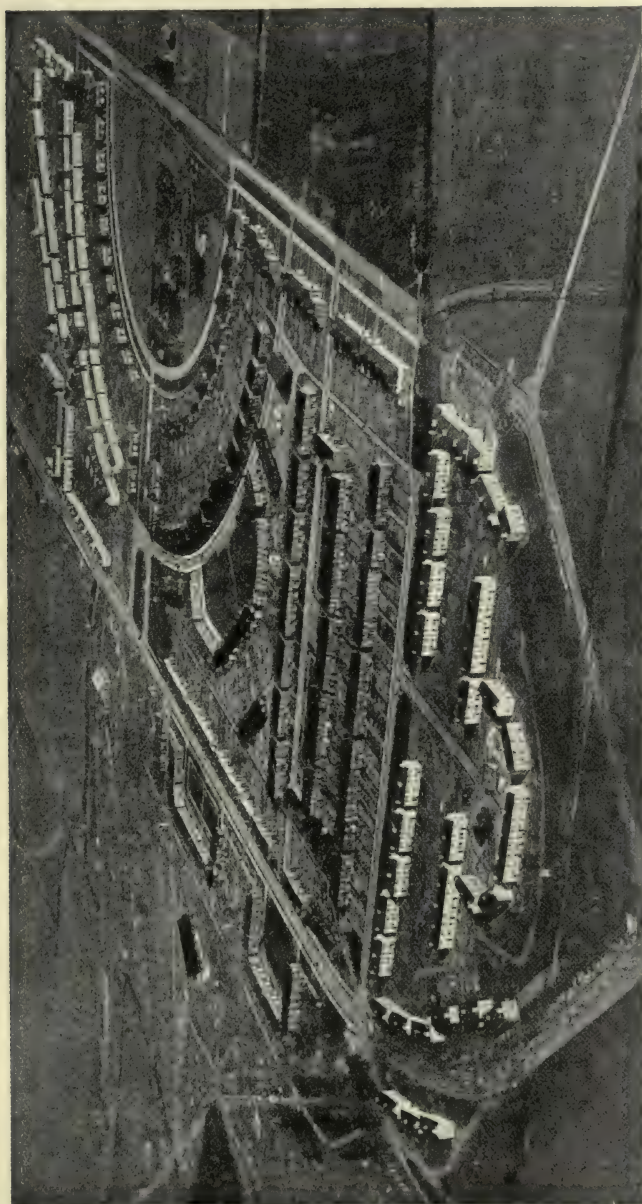


FIG. 39.—Aerial view of Dormanstown.

It will be obvious that the smaller the block, the more frequently do the gaps between the blocks occur. Detached houses naturally occupy the largest road frontage because the gaps between them are not only the most numerous, but the tendency is also to make them very much wider than is considered necessary in other cases. The additional road frontage required per house to allow for the gaps between blocks is inversely proportional to the number of houses in the block. Thus, assuming a minimum distance of 8 feet between the ends of buildings, the extra frontage per house amounts to 4 feet in the case of pairs, 2 feet for blocks of four, $1\frac{1}{3}$ feet for blocks of six, and so on in proportion. Apart, therefore, from the terrible monotony of repeated pairs, the expense of the additional frontage occupied is a factor to be taken into account, and the use of longer blocks will be found desirable from the economic as well as from the æsthetic standpoint.

Loss at Road Junctions.—The necessity for roads leading into and out of the road we are considering, is the cause of further loss of frontage, as illustrated in Diagram C, Fig. 40. It will be observed that although very little frontage is lost at an obtuse angle, the loss at the acute angle is so great that the advantage always lies with a right-angled junction. Other considerations naturally affect the type of road junctions that are used, but where it is reasonably possible it will be advisable from the point of view both of appearance and economy to adopt a right angle. The actual loss of frontage incurred at a corner will vary according to the set-back of the houses and the distance allowed between the back of the houses in the main street and the ends of those in the side street. But assuming the distance generally adopted in the Government Housing Scheme, it will be found (see Diagram C, Fig. 40) that there is a minimum loss of 95 feet 6 inches at each corner. The greatest economy of planning will,

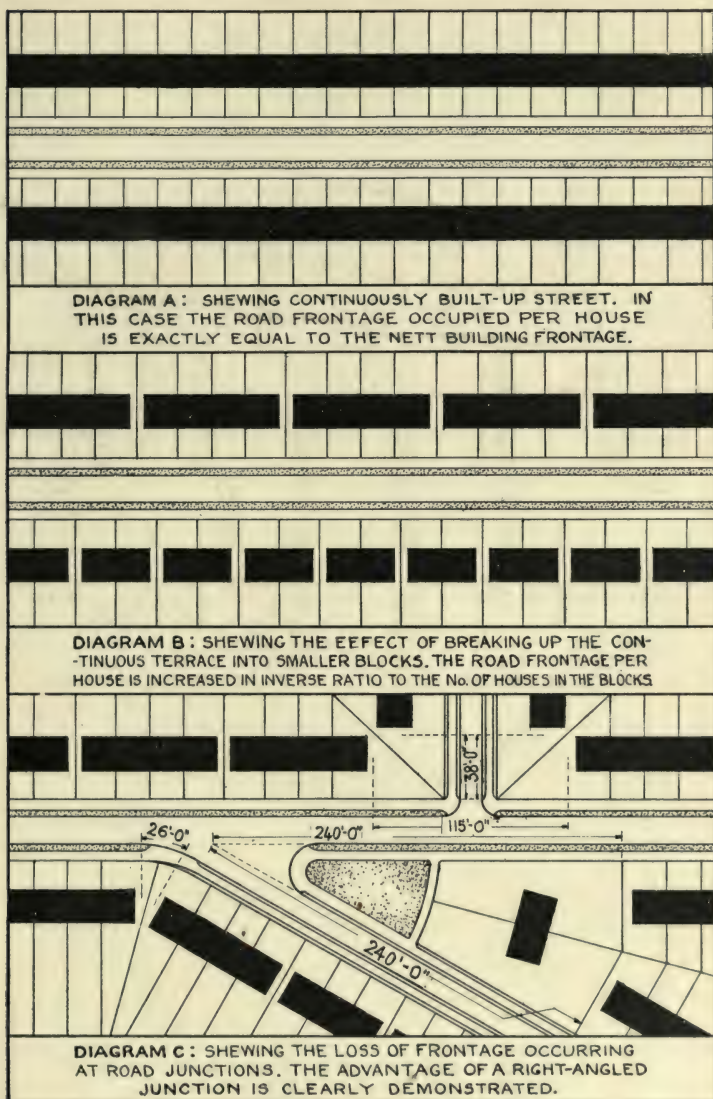


FIG. 40.—Diagrams illustrating the causes of loss of road frontage.

therefore, occur when the proportion of road junctions to the number of houses is kept as low as possible.

Concave Corners and Culs-de-Sac.—But there is another and a very important fact in connection with road junctions.

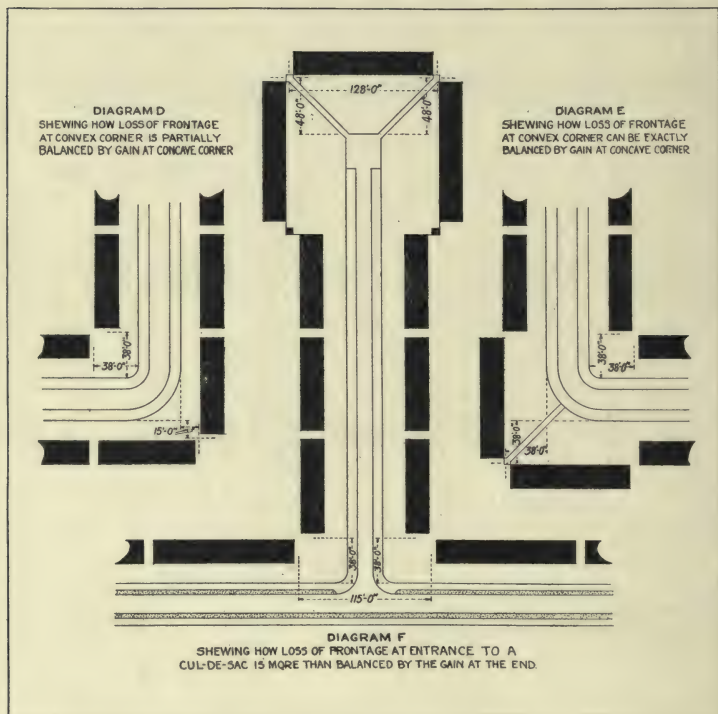


FIG. 41.—Diagrams illustrating how loss of road frontage at corners can be made good.

Up to the present we have considered only what may be called "Convex" angles, in which the houses all face outwards; it is now necessary to examine the characteristics of the "Concave" angle, in which the houses all face inwards. Diagrams D and E, Fig. 41, show the two typical cases for a rectangular corner. At D it will be seen that instead of losing frontage, a certain amount is

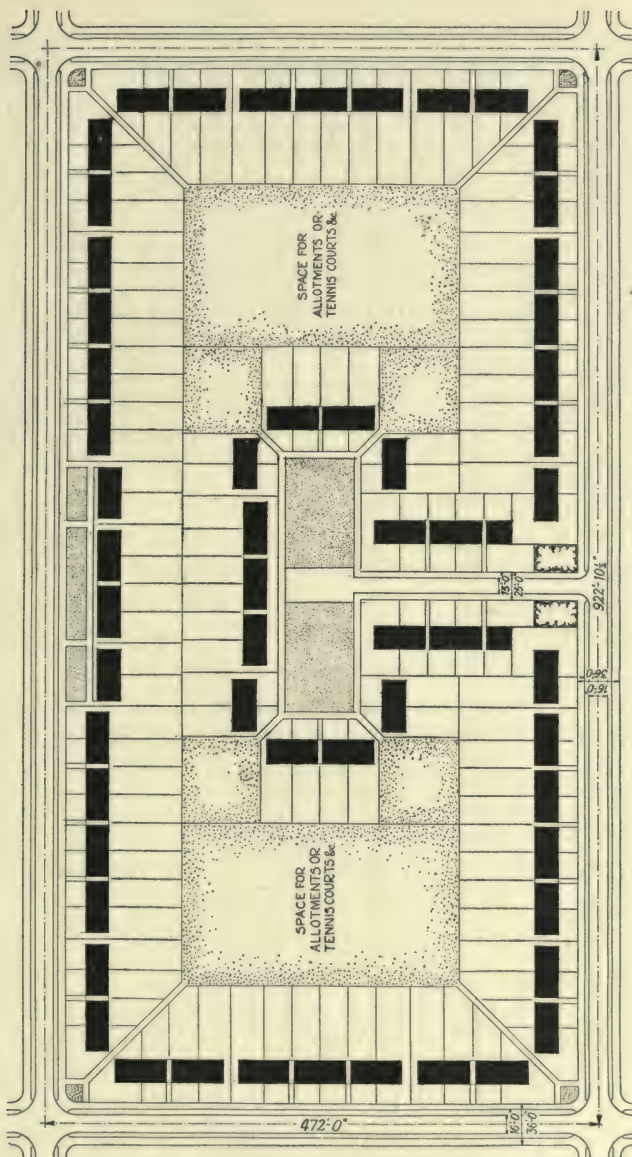


FIG. 42.—Diagram illustrating development of 10 acres of land at a density of 12 houses to the acre.

gained, and that the greater the set-back of the houses at the corner the greater will be the gain. If the houses are set back as at E, the amount gained at the "concave" corner exactly balances the loss at the "convex" corner—a circumstance of which it is frequently possible to take advantage. The most serviceable application of this principle is in the case of the cul-de-sac shown at F, Fig. 41. Here it will be noted, the saving effected at the end of the cul-de-sac more than balances the loss at the entrance. This is the explanation of the great economy obtained by the use of culs-de-sac; for while in every other case a road junction involves loss of frontage, in that of the cul-de-sac the net result involves no loss at all either in the main road, or in the cul-de-sac itself. There are definite limitations to the use of culs-de-sac which will be considered later; but if they are employed with discretion, and care is taken to avoid the objectionable features common to the older examples, they afford a very economical means of providing pleasant and secluded sites for houses. They are not, however, so well suited to development at a high density, where the closer proximity of the houses and the absence of freedom in planning rob them of all their charm and most of their economy.

Effect of Density on Road Planning.—Arrangement.—The effect of density upon the planning of the minor roads is illustrated in Figs. 42 and 43. In these two diagrams a comparison is made between the development of two rectangular plots each 10 acres in extent, at densities of 12 and 20 houses to the acre respectively; both sites are assumed to be surrounded by roads 36 feet wide. In order to accommodate the requisite number of houses at the higher density, it becomes necessary to introduce two additional roads for the full length of the site; but at the lower density, the majority of the houses can be accommodated upon the four principal roads and a short sub-

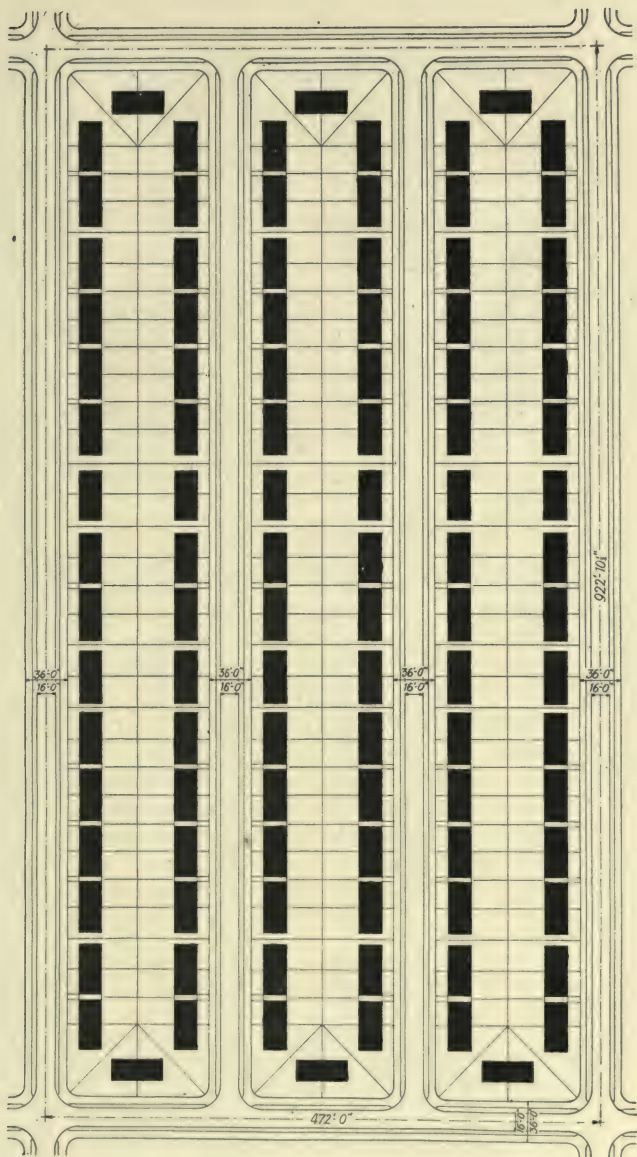


FIG. 43.—Diagram illustrating development of 10 acres of land at a density of 20 houses to the acre.

subsidiary road only is necessary to provide frontage for the remainder. The actual length of frontage used in the two cases amounts to 6265 feet for the 204 houses at a density of 20 to the acre, or an average of 30·71 feet per house; while only 3214 feet are required for the 120 houses at a density of 12 to the acre, or an average of 26·78 feet per house. Thus it will be seen that houses having exactly the same building frontage can be arranged to occupy less road frontage at a lower than at a higher density. Comparison with Diagram A, Fig. 40, will explain why this is so. In that case, the road frontage per house was the exact building frontage, no matter at what density the houses were placed. In Figs. 42 and 43 there is a difference between the average road frontage and the average building frontage per house of 3·68 feet and 7·61 feet respectively. These figures represent the losses occasioned by road junctions and the gaps between the ends of the buildings, neither of which occurred in the case of A. The proportion of gaps to houses in Figs. 42 and 43 is almost exactly the same, so that the economy in frontage obtained by the arrangement shown in Fig. 42 is due entirely to the saving effected on losses at road junctions. It will be observed that in Fig. 43 there are no less than 12 "convex" angles, whereas in Fig. 42 there are 8 "convex" and 4 "concave" angles. The effective number of "convex" angles in the latter case is thus reduced to 4, and this lower proportion of corners is responsible for the result obtained.

Cost.—But the economy of such an arrangement is not measured merely by the actual length of frontage saved, because, as nothing but the lightest traffic will have to be carried by the cul-de-sac, a narrower width and lighter construction can be used for this road than would be possible in the case of the subsidiary roads in Fig. 43. The following table gives comparative figures for the two types of development :

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TABLE III.—COMPARATIVE STATISTICS IN REGARD TO THE DEVELOPMENT OF TWO PLOTS OF 10 ACRES AT DENSITIES OF 12 AND 20·4 HOUSES TO THE ACRE, RESPECTIVELY.

Total area of site Acres	10	10
Area occupied by roads "	1·35	2·59
Net area of site "	8·65	7·41
Number of houses "	120	204
Gross density per acre "	12	20·4
Net density "	13·87	27·52
Average net area of house plot Square yards	350	176
Average net building frontage per house Feet	23·1	23·1
Average road frontage per house: Total "	26·78	30·71
36 ft. road "	22·65	30·71
Light road "	4·13	—
Cost of roads and sewers per house £ s. d.	43 5 0	52 5 0
36 ft. road @ £1 14s. od. per foot frontage "	38 10 0	52 5 0
Light road @ £1 3s. od. "	4 15 0	—
Cost of land per house @ £180 per acre "	15 0 0	8 16 6
Cost of land and development per house "	58 5 0	61 1 6
Cost of house plot per square yard net "	0 3 6½	0 6 11¼

It will be noted that at the cost of land and road and sewer construction current during the period of the Government Housing Scheme, the total expenditure per house plot for land and development charges is slightly less at the lower density than at the higher density, although the net area of the plot in the former case is more than double that of the plot in the latter.

Comparative tables of this kind usually show that increased density results in a slightly reduced total cost per plot. This is attributable to two causes. Pre-war comparisons were based upon conditions under which the cost of the land was a much more important item in the cost of the developed house plot than it is to-day. It was usual to assume a price of £300 per acre for land, and at this rate the cost of the land represented 50 per cent. of the total cost in the case of a density of 12 to the acre, and 33 per cent. in the case of a density of 20 to the acre. But as the average cost of the land has been in the neighbourhood of £180 per acre, or only 60 per cent. of the pre-war assumption, while the cost of roads and sewers has at least

doubled, the proportion borne by the cost of the land to the total cost of the plot is now reduced to 23 per cent. and 15 per cent. respectively. Hence any system which economises in road making has a great advantage, and a reasonable generosity in the use of land is compensated by an equivalent saving in the cost of road and sewerage works.

The other factor which influences the result is the question of building frontage. It has been usual to assume much wider frontages in the case of the low density than in the high. This does not afford a fair comparison, because within reasonable limits, both of frontage and density, the two matters are independent, and there is no reason why houses having the same frontage should not be used in the one case as in the other. However, without labouring the point further, it will be clear that if any value is attached to the greater area of land which is available both for increasing the size of the individual plots and for use as tennis grounds and other communal purposes, development at 12 houses to the acre is much more economical than at a higher density, because the benefit of the extra land is obtained at almost exactly the same cost. It will also be clear that if the reduced density is adopted—as it has been throughout the Government Housing Scheme—a type of development is required which is economical in development charges and makes the utmost legitimate use of light roads and culs-de-sac.

Subdivision of Land into Building Blocks.—*Size.*—Without attempting to lay down any precise rules for the arrangement and spacing of these minor roads, attention may usefully be directed to certain principles of design which are of general application. The most important of these is the size and shape of the blocks of land into which it is most economical to divide the areas enclosed between the system of secondary streets. We are here confronted by two opposing considerations : on the one hand, the need for convenient access imposes an upward limit

upon the size of the blocks,* while, on the other hand, the necessity for economy in development requires that they should not be too small. Convenience of access in this respect need only be considered from the point of view

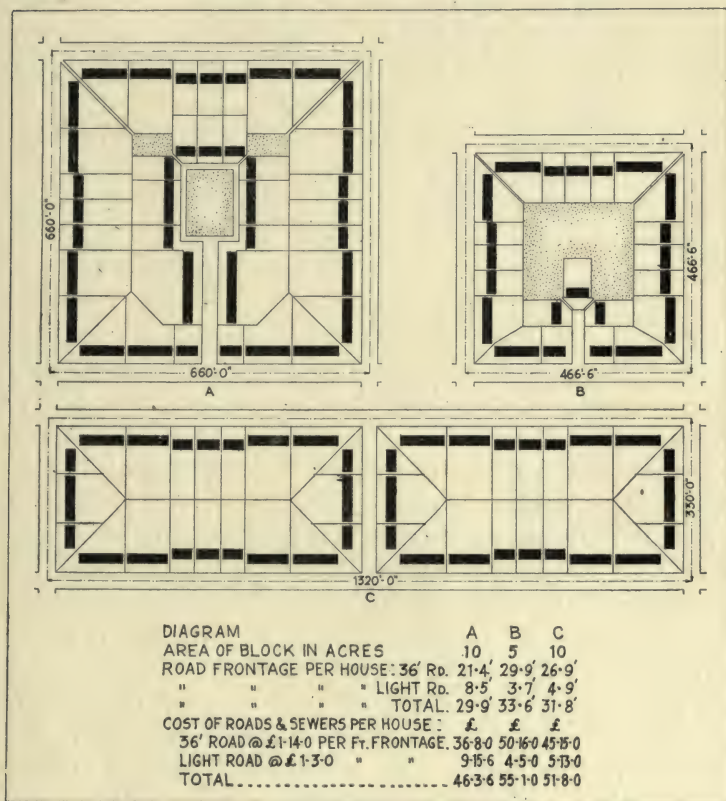


FIG. 44.—Diagram showing comparative cost of development for Rectangular Blocks of different sizes and shapes. Compare with Figs. 45, 46, and 47.

of wheeled traffic, as provision for foot passengers can be provided without materially increasing the cost of development or modifying the lay-out. Even then it is difficult to decide at what point access becomes inconvenient, especially as in development at 12 houses to the acre the

shape of the different blocks will be far from uniform. Hence a lineal dimension must also be accompanied by a superficial measurement, and on this basis it will usually be found that blocks having an area of approximately 10 acres and with no side exceeding a length of a quarter of a mile, constitute the most economical units of development. An example of such a unit is illustrated in Fig. 42, and further examples are shown in Figs. 44-47.

Shape.—The shape of the block is not of paramount importance in the case of open development, as the reduced density allows greater freedom of planning, and parallel roads—two house plots apart—are not only not essential, but, being generally less economical than other arrangements, are to be avoided as far as possible. Provided, therefore, that the blocks are not too narrow, nor too acute-angled, almost any shape can be developed economically. The majority of those used in practice, however, can be considered in relation to the following typical figures—the rectangle, triangle, trapezium, and segment of a circle. The sector and part-sector of a circle—forms frequently encountered—can conveniently be approximated respectively to a triangle and trapezium for the rough calculations that are necessary, while blocks of a shape too irregular for comparison with any of the standard figures must necessarily receive individual examination.

Proportions.—In order to arrive at the proportions which are theoretically the most economical for development, several factors have to be considered. At first sight it would seem that from the point of view of available frontage, those proportions would be best which result in a figure possessing the maximum perimeter for the area enclosed. If this were the only consideration, long narrow shapes such as those illustrated in Fig. 43 would be preferable to squares or circles in which the ratio of the periphery to the area enclosed is at a minimum. But the other factors in the case act in the opposite direction. The

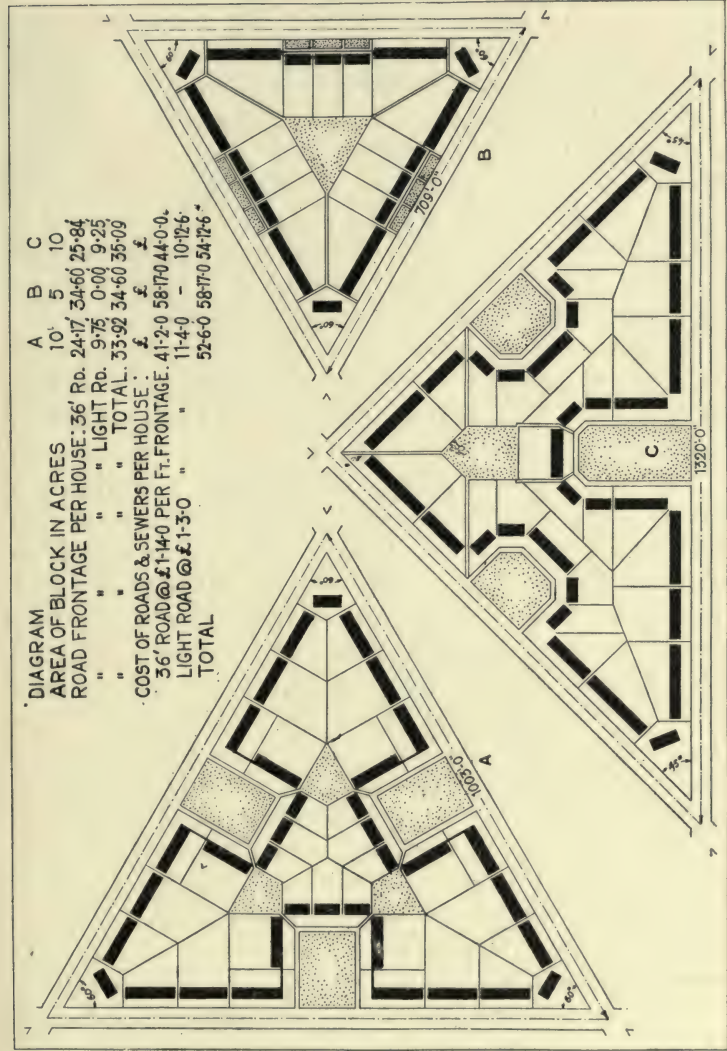


FIG. 45.—Diagram showing comparative cost of development for Triangular Blocks of different sizes and shapes. Compare with Figs. 44, 46, and 47.

limitations as to area and length imposed by traffic requirements automatically prevent the adoption of the long narrow block, while the difference in cost between the light roads which can be used for the internal development of the block, and the heavier roads surrounding it, renders it desirable to make the maximum possible use of the light roads. On this account, therefore, it is advisable to employ blocks having a small perimeter but at the same time offering the greatest opportunity for internal development by means of light roads, culs-de-sac, etc. A further guide in the matter is the desirability of reducing the loss at corners to a minimum. This factor does not affect the shape of rectangular blocks, but it has a direct bearing upon that of the other typical shapes. It has already been pointed out that the waste of frontage at a road junction is least in the case of a right angle owing to the increased loss occurring at an acute angle being much greater than the diminished loss at an obtuse angle. Hence in the case of triangular, trapezoidal, and segmental blocks, the most economical form will be that in which the angles most nearly approach right angles; an equilateral triangle will, therefore, be the best shape in its group, and a semi-circle in the segmental class. But while a trapezium obviously grows more economical as it approaches the rectangular form, it loses at the same time its own characteristics, and if these are to be preserved, it is necessary to set up an arbitrary standard; under these circumstances it may be said that for a typical trapezium the best shape is that in which the acute angles are about 60° .

Dimensions.—The actual dimensions of the different shaped blocks which comply with the foregoing conditions with regard to area, length of side, perimeter, and angles at corners, can readily be determined. Thus, amongst rectangular shapes, a square having sides 660 feet long fulfils the conditions as to area, length of side, and angles, and at the same time possesses the minimum possible

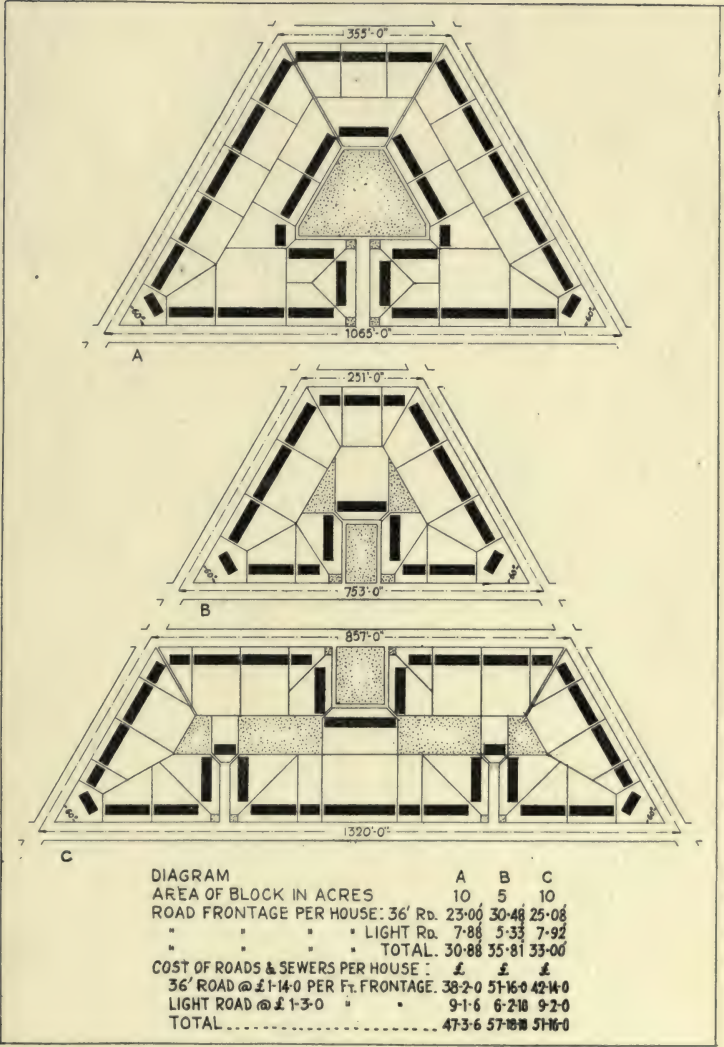


FIG. 46.—Diagram showing comparative cost of development for Trapezoidal Blocks of different sizes and shapes. Compare with Figs. 44, 45, and 47.

perimeter ; it is clearly, therefore, the most economical form of rectangle. The limitation of the angles to 60° at once determines the shape of triangular blocks, and the equilateral form also provides the smallest perimeter ; with sides equal to, in round numbers, 1000 feet, an area of 10 acres is enclosed without exceeding the permissible length of side. In the case of the trapezium, as in that of the rectangle, the perimeter is the deciding factor ; this is at a minimum when the length of the side equals the mean between the top and base, and for the required area the dimensions will be, base 1065 feet, top 355 feet, and sides each 710 feet. It is difficult to determine the most economical proportions for the segmental form. The more nearly it approaches a complete circle, the greater will be the economy in the length of the boundary road ; but, on the other hand, the internal space is more difficult to develop, and, with the smaller radius required to enclose the specified area, the disadvantages of tapering plots and the additional loss between the blocks of houses inherent in the circular form, are intensified. Moreover, where complete circles are used, they almost invariably occupy the centre of a scheme of roads based upon the spider's web, and, for convenience of traffic, are divided into sectors by the principal roads. This is also generally true of all segments greater than a semicircle, so that we may reasonably confine our attention to segments equal to or less than a semicircle ; of these, the semicircle is from every point of view the most economical form ; a diameter of 1052 feet will give the requisite area.

The dimensions of these typical shapes have been worked out in some detail in order to ascertain the most economical form in each case. These data will be a most useful guide in the determination of the general lay-out of the minor roads, but it is not, of course, suggested that the objects of estate development will be achieved by the adoption of certain standard geometrical figures. There

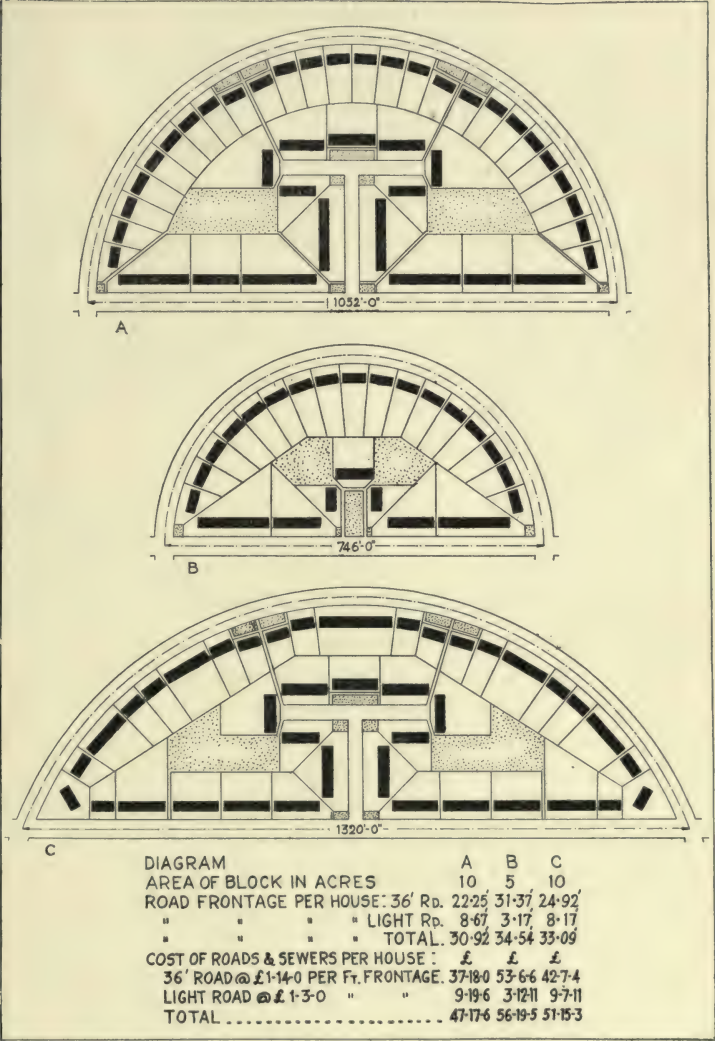


FIG. 47.—Diagram showing comparative cost of development for Segmental Blocks of different sizes and shapes. Compare with Figs. 44, 45, and 46.

are always some local considerations which influence the lay-out in a particular direction, but, at the same time, in any plan for a reasonably flat site, the roads must inevitably cut up the land into blocks corresponding to one or other of the typical shapes we have been considering, and it is useful, therefore, to have certain standards which are known to be the most economical in their class and to which, accordingly, it is desirable to approximate as closely as the exigencies of the particular case allow. There will, however, be many instances where anything like a close approximation is not practicable. In the rectangular and trapezoidal figures, especially, there is likely to be considerable divergence between the practical and theoretical proportions, and in such cases it becomes essential to consider the effect upon the shape of the block, of the size and shape of the house plot.

House Plots.—The individual house plot is ultimately the unit upon which the lay-out of the minor roads is based. So far it has been unnecessary to discuss this unit, because the subdivisions of land we have been considering are of sufficient size to accommodate conveniently house plots of any dimension within the limits imposed by a density of 12 to the acre or thereabouts, and by the average frontage required to comply with modern standards of cottage design. But for the internal development of these blocks, and wherever it is necessary in fixing the distance between roads to make sure that they will be an even multiple of plot-depths apart, it is necessary to decide upon the dimensions of the house plot. The superficial area of the plot depends, of course, upon the average density of houses to the acre, and in this connection it is important to distinguish between "gross density" and "net density." Gross density may be defined as the total number of houses divided by the acreage of the site after deducting the area of land reserved for buildings other than houses, and for large open spaces not forming part

of the provisions for the Scheme. Net density is the total number of houses divided by the acreage devoted to the actual house plots, and such minor open spaces as may be provided in place of dividing such land into private gardens ; in addition, therefore, to the deductions made in calculating the gross density, the area occupied by the roads and the ordinary open spaces provided in connection with the scheme are excluded in arriving at the net density. The difference between the two measures is considerable. Upon the average, the land devoted to open spaces provided in connection with the scheme amounts to 10 per cent., and that occupied by roads to 15 per cent. of the gross area of the site. Hence a gross density of 12 to the acre results in a net density of 16 to the acre, and in order to secure a net density of 12 to the acre it is necessary to reduce the gross density to 9 ; in other words, the net density is usually about four-thirds of the gross density. The area of the house plots varies inversely as the density ; thus a net density of 12 to the acre gives to each plot an average of 400 square yards, while a gross density of 12 to the acre—equivalent to a net density of 16—provides plots of only 300 square yards.

The actual density adopted will depend to some extent upon local circumstances—it being obviously unwise to attempt standardisation in a matter regulated by such variable factors. But in view of the fact that the greater part of the existing housing accommodation is planned at a very high density, and that there is accordingly a marked shortage of houses with gardens which are large enough to be worth while cultivating, it is generally agreed that wherever possible an average net density of 12 houses to the acre should be adopted. This yields a plot having, as previously mentioned, an area of 400 square yards. The frontage required varies with the class of house, the aspect, the number of houses in the block, and the distance between the ends of the blocks. Taking 18 feet as the minimum

allowable frontage for the Living-room type of house, and 26 feet as the maximum economical frontage for the Parlour type of house, and assuming that the average number of houses in a block is four, with one passage way in the middle 4 feet wide, and gaps between the ends of the blocks 8 feet wide, the average building frontage required amounts to 25 feet. For this width a depth of 145 feet is necessary to afford the needful area ; here again this is not a dimension to be rigidly applied, but to serve as a guide in fixing the distance which should be allowed between the roads. Where, for example, it is necessary to make use of parallel roads, the minimum distance between them will be two plot depths, or approximately 290 feet. A more economical arrangement is to place the principal roads four plots, or 580 feet, apart, and to develop the interior land by means of lighter and less expensive roads. It will frequently happen that owing to the shape of the building block and also because of the difficulties encountered at corners, rectangular plots cannot be provided economically. This is not of great consequence, as there is no serious reason why all the gardens should be precisely the same size and shape, and it is, in fact, rather an advantage than otherwise to cater for the differing requirements that are sure to be encountered. Figs. 44-47 illustrate the development of various forms of the typical shapes at an average net density of 12 to the acre, and with an average building frontage of 25 feet per house. The comparative cost of development is also given as an index of the relative economy of each type.

Street Orientation and Distance between Buildings.—

There is another consideration affecting the lay-out of the minor roads, and that is the question of the aspect given to the houses and the amount of sunlight they are able to enjoy. It is beyond dispute that in a country with a climate like that of England every hour of sunshine is valuable, and it is worth while making considerable efforts to secure that our houses and streets are as sunny as

possible. To this end it is necessary to consider the combined effect of the height and distance apart of the buildings and of the orientation of the road, upon the number of hours during which the sun can shine in the street at different seasons of the year.

In the course of two articles contributed to the *Town Planning Review* (vol. viii. No. 2, and vol. ix. No. 1), Mr. A. Trystan Edwards has presented the result of a detailed examination of this subject, and for full information upon the question and the methods by means of which the results were obtained, the reader cannot do better than refer to this source. For our present purpose, however, a summary of the conclusions which Mr. Edwards has reached will probably meet the case. The amount of sunlight enjoyed in any street can be regarded from two points of view. The hours during which the sun can shine on the fronts and backs of the houses in the street irrespective of the angle of the rays, is one criterion, while the other is the amount of direct sunlight which effectively penetrates the rooms. It will be apparent that the possible hours of sunlight will be considerably less in the latter case than in the former, because sun's rays entering a window at a very oblique angle cannot be considered to have much hygienic value, and "effective" sunshine has been defined, therefore, as that entering a room in a direction of which the vertical plane is at an angle of not less than 45° with the wall surface.

In order to ascertain the incidence of sunlight in streets of various widths and directions, Mr. Edwards prepared two sets of graphs, one showing the sum of the hours during which the whole wall surface of the front and back of the house respectively are completely illumined, and the other showing the sum of those hours, only, when the windows are penetrated by "effective" sunlight. In both diagrams the general characteristic of the graphs is that the rate of change of the curve is very rapid at first

and very slow towards the end ; in other words, when the distance between the buildings is small, a small increase of width results in a large increase of sunlight ; but when the street is wide, even considerable alterations in the width have very little effect upon the hours of sunlight. This peculiarity is most noticeable in streets approximating to the direction of east and west, because to an observer on the north side of such a street the sun appears to be in a path which, for a long distance, almost coincides with the top of the buildings opposite, so that a small increase or decrease in the width of the street makes all the difference between sunshine and shadow. In the case of these streets the graphs exhibit special critical points at which very nearly the maximum amount of sunshine is secured at a certain width, and is almost entirely lost at any less width. For example, a street running due east and west composed of cottages 18 feet high would at midsummer have eleven hours possible sunshine if it were only 10 feet wide, while at the Equinox it only requires to be 24 feet wide to secure the same amount. But, in the latter case, if the width were reduced to 20 feet—or only 4 feet less—ten hours of sunlight would immediately be lost. In the graphs for streets approximating to the north and south direction these critical points are not so clearly marked, but there are nevertheless optimum widths below which the hours of sunlight decrease very rapidly in proportion to the distance between buildings and above which the increase of sunlight is too small to justify the increased width necessary to secure it.

Further examination of the diagrams reveals the fact that during spring, summer, and autumn the optimum widths are greater in the case of roads running approximately north and south than for those running east and west, but that in winter the position is reversed. Also that for roads running roughly east and west 80 per cent. of the possible sunlight is secured at midsummer and the

equinoxes by a very moderate width, while a very great increase of width is necessary to secure anything like the same proportion during the winter. In the case of streets approximating to north and south, any increase of width beyond the optimum width for the equinoxes produces only a negligible increase in the hours of sunlight at midwinter. These characteristics are rather more marked in the graphs showing hours of effective sunlight, in that houses upon streets running in a direction approaching north and south secure no *effective* sunlight during the winter months, however far apart they may be placed.

It will be clear, therefore, that in fixing the distance between houses it is desirable to take into consideration the incidence of sunlight at periods of the year other than midwinter. Instead of adopting a uniform width of 70 feet or any other fixed dimension, it would be more reasonable to regulate the width according to the conditions which obtain during the greater part of the year, and also according to the orientation of the road and the height of the buildings. A further argument in favour of this method is supplied by the following table (reproduced by courtesy of

TABLE IV.—AVERAGE NUMBER OF POSSIBLE HOURS OF SUNSHINE PER DIEM FOR EACH MONTH, AND THE PERCENTAGE ACTUALLY RECORDED ON THE AVERAGE OVER A PERIOD OF TEN YEARS

Month.	Average Number of possible Hours of Sunshine per Diem.	Percentage of the possible Duration actually recorded.	Month.	Average Number of possible Hours of Sunshine per Diem.	Percentage of the possible Duration actually recorded.
January . .	8 h. 20 m.	10'2	July	16 h. 03 m.	33'3
February . .	9 ,, 53 ,,	16'3	August	14 ,, 32 ,,	36'4
March . .	11 ,, 47 ,,	21'1	September	12 ,, 39 ,,	37'7
April . .	13 ,, 46 ,,	34'3	October	10 ,, 40 ,,	27'7
May . .	15 ,, 29 ,,	41'5	November	8 ,, 53 ,,	15'7
June . .	16 ,, 29 ,,	40'1	December	7 ,, 53 ,,	9'9

Mr. Edwards), showing the average percentage of possible sunshine actually enjoyed in England during each month of the year. To gain additional emphasis, a parallel column is added giving the average number of hours during which sunshine is possible.

It will be noted that in the winter months not only are the possible hours of sunshine very much reduced, but that, in addition, only 10 per cent. of these possible hours are actually enjoyed, as compared with 30 per cent. at the equinoxes and 40 per cent. at midsummer. There can be little doubt, therefore, that the conditions for which it is most worth while to plan are those obtaining from the beginning of March to the end of October.

Without exploring the matter further, it will be apparent that the investigations summarised in the preceding pages have established at least two facts of great importance in practical site planning. In the first place, it would appear that, so far as sunlight is concerned, no great advantage attaches to any particular aspect for houses in streets of continuous or virtually continuous buildings. And, secondly, the principle of graduated widths already applied to the actual roadways can reasonably be extended to the distance between the buildings fronting on to these roadways. Thus, without making any sacrifice in the domain of Health and Hygiene, it will be possible to introduce into our modern housing schemes something of the charm and variety associated with the streets of old towns.

The Special Problems of Hilly Sites.—So far we have considered the principles which apply to the development of comparatively level land where topographical considerations are not dominating factors in the arrangement of the roads. With undulating or hilly sites, however, economical development will depend more upon the close adaptation of the lay-out plan to the contours of the ground than upon anything else. Although this is true of the whole scheme of roads (for both the main and secondary streets have to



FIG. 48.—Appearance of road running parallel with the contours of the ground.



FIG. 49.—Skilful treatment of road running diagonally to the contours.

be located with a proper regard for the configuration of the ground and the best gradients obtainable), it is particularly true of the system of minor roads. Upon a flat site we have seen that the disposition of these roads is influenced very largely by the suitability of the shape and size of the blocks into which the land is subdivided ; but on a hilly site, while this factor should not be lost sight of, the most important requirement is to lay out the roads in such a way that the extra expense in the construction of the roads and sewers, and in connection with the foundations for the houses—inevitably associated with hillside development—shall be reduced to a minimum.

Direction of Roads relative to Contours.—There are three main directions which the roads may take in relation to the contour lines, namely, parallel with, at right angles to, and diagonally across them. Roads planned to follow the contours provide building sites having a slope from back to front on the higher side, and from front to back on the lower side of the road. This usually involves both excavation and underbuilding, the amount depending upon the steepness of the slope ; but if houses having wider frontage and narrower depth are placed in such positions, this disadvantage is less noticeable. There will also be a difference in level between houses on opposite sides of the road that, from the point of view of appearance, is not altogether pleasing ; but, on the other hand, the houses will be square with the slope of the land and will maintain a roughly horizontal eaves line, while the slope of the garden lends itself to the formation of regular terraces parallel with the buildings. Where the slope is not too steep, roads at right angles to the contours have several advantages. The special charm of a site often lies in the fact that it is situated upon a height, and it will sometimes be desirable to emphasise this by driving some of the roads or footways straight up the hillside without paying too much attention to the gradient. Many old villages and towns contain most



FIG. 50.—“The special charm of a site often lies in the fact that it is situated upon a height.” (Amersham Housing Scheme.)



FIG. 51.—Closer view of houses at Amersham illustrated in Fig. 50.

attractive examples of such treatment. But, apart from the æsthetic value they possess, these roads are both neces-



FIG 52.—High Street, Hatfield.

sary and economical. Unless the gradient is excessive the construction of the roads and sewers involves no greater expense than if the site were flat, and drainage difficulties are reduced to a minimum. The houses facing each other

are level, which gives a feeling of balance to the street, and the scope for interesting architectural treatment is very great (see Figs. 52-55). On the other hand, the houses are likely to prove rather more costly on account of the frequent alterations in the level of the foundations and



FIG. 53.—Mermaid Street, Rye.

roofs, and there is a danger that in unskilful hands the resulting appearance may be far from pleasing. In order to secure easier gradients or convenient directions, many roads will have to be planned diagonally to the contours. Secondary roads giving access to and connecting up a number of minor roads running parallel to the contours, will

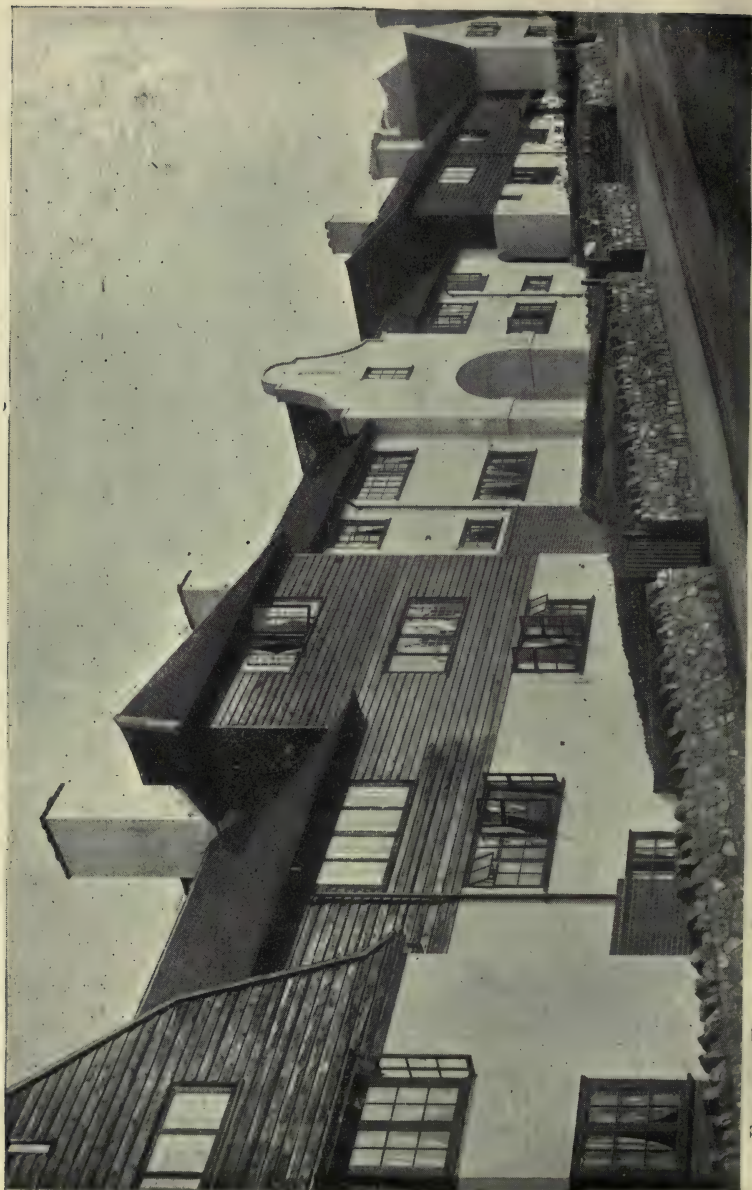


FIG. 54.—Treatment of steep street in Housing Scheme at Folkestone. Ewart G. Culpin & R. S. Bowers, Architects.



FIG. 55.—Treatment of road running at right angles to contours in L.C.C. Housing Scheme at Norbury.
G. Topham Forrest, Chief Architect.

frequently have to take this course; but it should be recognised that such roads do not provide convenient building sites, as the houses stand diagonally to the slope of the land—a position combining the disadvantages of frontage upon roads which are parallel with and those which are at right angles to the contours.



FIG. 56.—Housing Scheme at Dartford. Crickmer & Foxley, Architects.

Treatment of Regular Slopes.—Roads in all three directions will usually be required, but the degree of steepness and the general configuration of the ground will naturally determine the mode of their arrangement. Where, for example, the slopes are fairly regular and not too steep, a

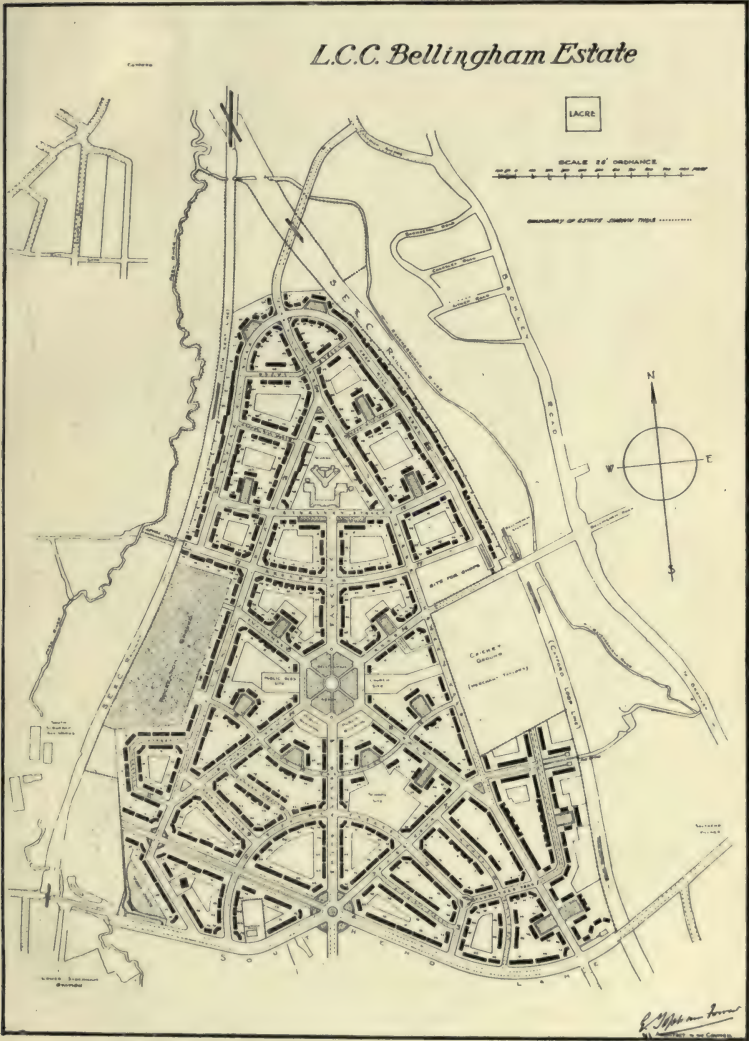


FIG. 57.—Lay-out of L.C.C. Housing Scheme at Bellingham.
G. Topham Forrest, Chief Architect.

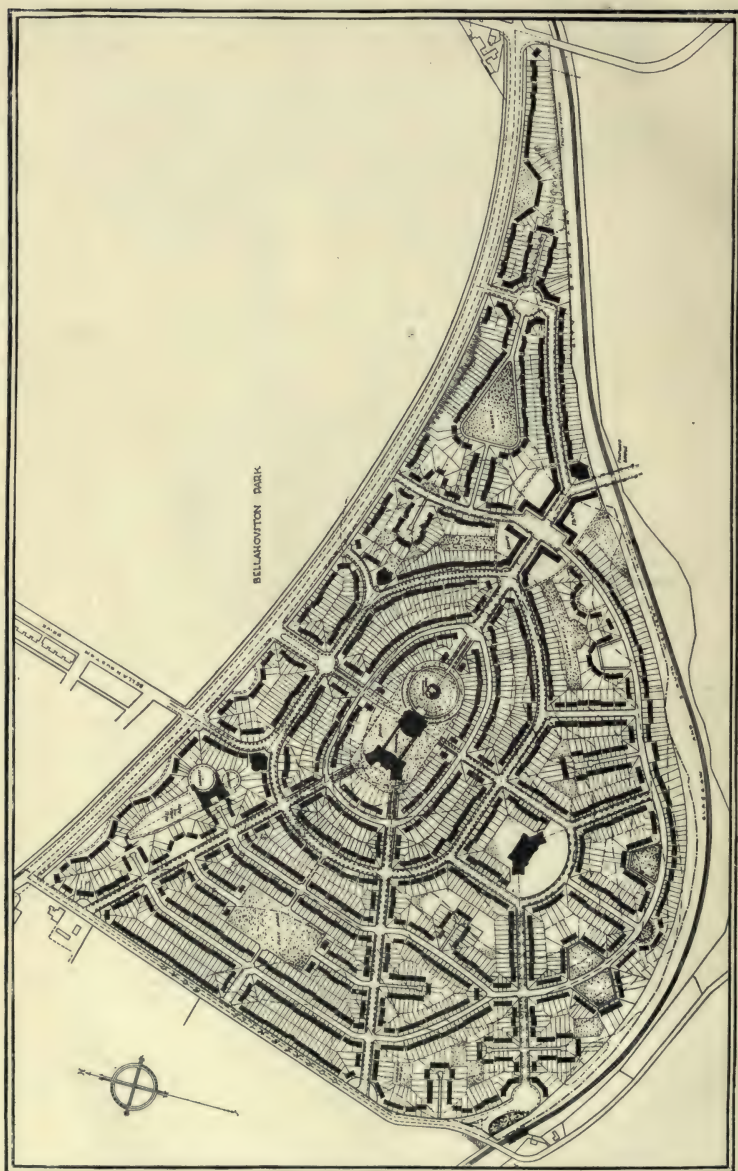


FIG. 58.—Lay-out plan for Moss Park site, Glasgow. First premiated design by Longstreth Thompson, R. Dann & S. P. Taylor, Architects.

more symmetrical treatment is possible than if the land is precipitous or the surface very irregular. The develop-

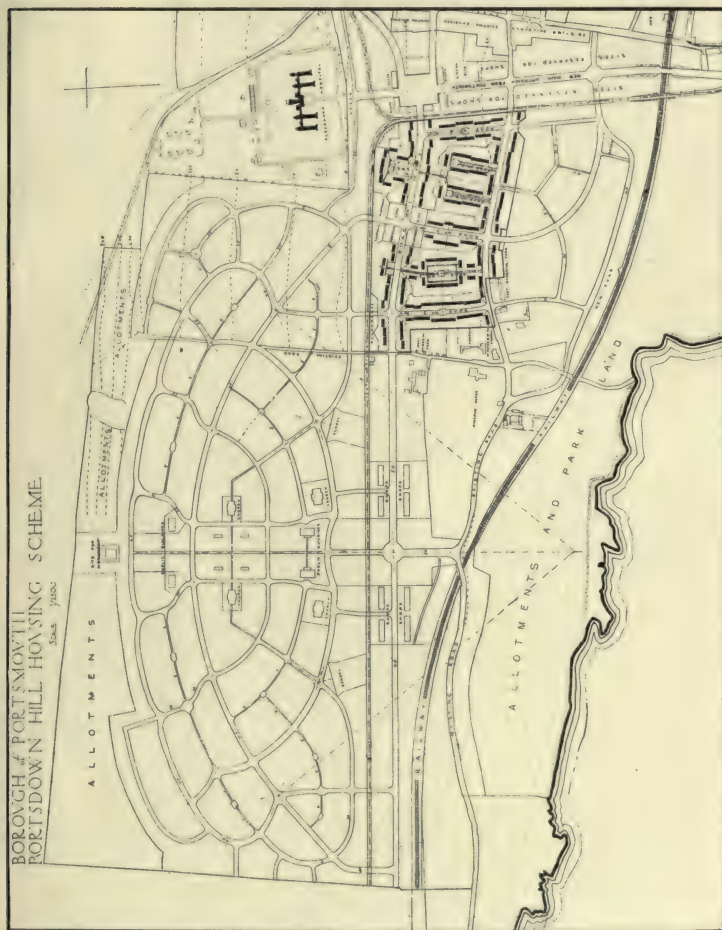


FIG. 59.—Lay-out of Portsdown Hill Housing Scheme, Portsmouth.
Lanchester, Rickards & Lucas, Architects.

ment plans for the Housing Schemes at Dartford, Chesterfield (Highfield Hall Estate), Newburn-on-Tyne (Throckley), Glasgow (Moss Park), Portsmouth, and Sheffield (Manor

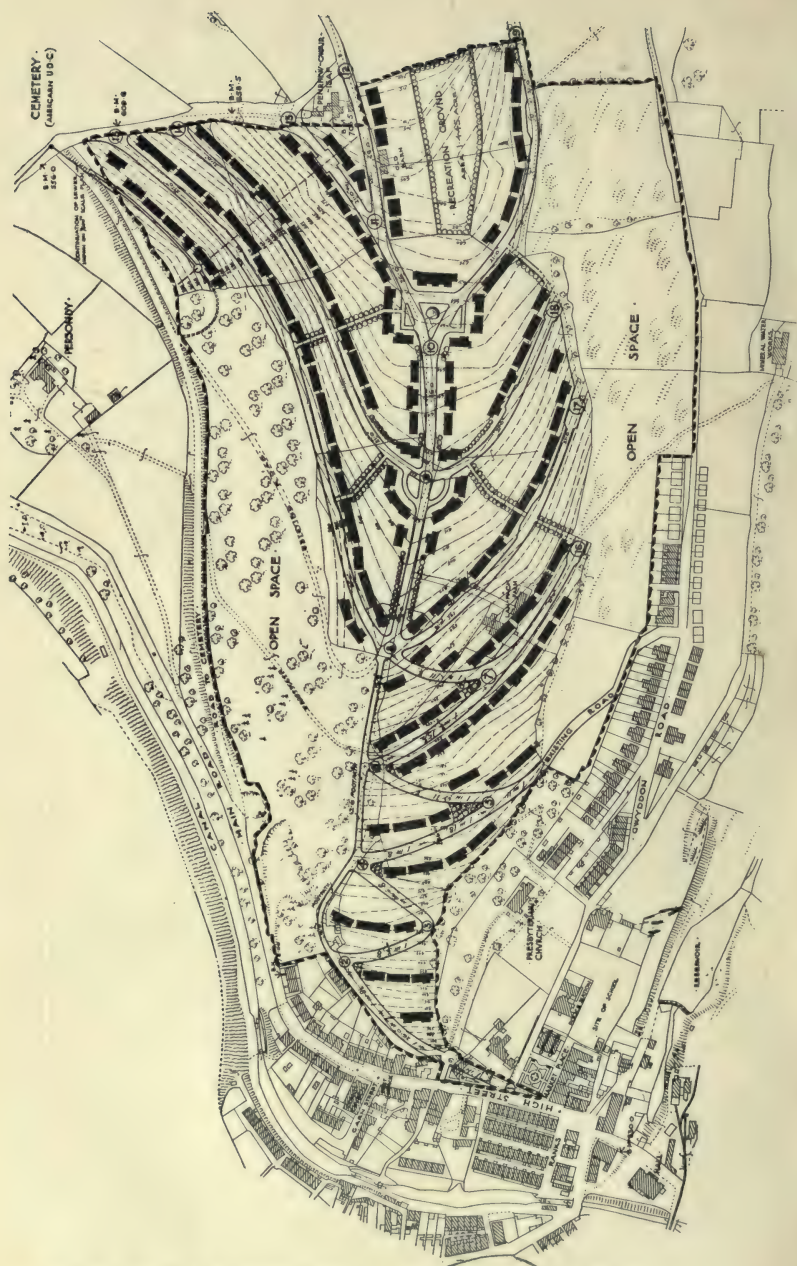


FIG. 60.—Lan Fâch Housing Scheme, Abercarn. Percy B. Houston, Architect.

Estate) illustrated by Figs. 56, 74, 22, 58, 59, and 15 are examples of the different ways in which such conditions have been met. It will be noticed that there is a tendency to cut up the land into much smaller blocks than have been recommended for the economical development of flat sites. This is generally due to the fact that upon hilly sites the greatest all-round economy is secured by planning the majority of the roads in a direction parallel to the contours ; under these conditions large compact blocks are more difficult to develop than small narrow ones, and even if originally laid down they are almost invariably reduced to the latter form. But while there is a good reason for employing smaller units of development upon hillsides, this policy is in danger of being carried to excess, and the absurdly small blocks that are sometimes to be seen are both inconvenient and extravagant.

Treatment of Undulating Land.—Where the configuration of the ground is irregular it is better to employ a frankly informal treatment, closely adapted to the contours. Examples of schemes developed upon this principle will be found in Figs. 19 and 60-65, which show the lay-out plans for sites at Barry (Glamorgan) ; Abercarn (Lan Fâch), situated upon a mountain spur of peculiar formation ; Nottingham (Sherwood Estate), where the governing features are the two valleys penetrating the site towards the south-eastern and south-western corners respectively, the bastion upon which is placed the Club, and the stream running along the northern boundary ; Brighton (Moulescombe), nestling in a hollow of the Downs which provides, in the shape of a typical Sussex village green, the central feature of the design ; Dover, on the eastern portion of which a somewhat similar arrangement has been followed ; Wakefield (Thornes Park), where the plan has been greatly influenced by the contours and the desire to preserve existing trees ; and the Shettleston and Tollcross scheme at Glasgow, which reflects the somewhat unusual topography of the site

CITY OF

SHERWOOD ESTATE



NOTTINGHAM

COMPETITION

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FIG. 61.—Lay-out plan awarded second premium in Nottingham, Sherwood Estate Competition.
Longstreth Thompson, R. Dann & S. P. Taylor, Architects

Treatment of Steep Slopes.—When the land is very steep, *i.e.*, at a slope of 1 in 6 or less, development by means of narrow roads, running parallel with the contours and



FIG. 62.—Lay-out of Moulescombe Housing Scheme at Brighton.
Adshead & Ramsey, Architects.

providing sites for houses on the upper side only, is the most economical method. These roads should be given sufficient fall to afford natural drainage for the surface water and suitable gradients for the sewers, and they

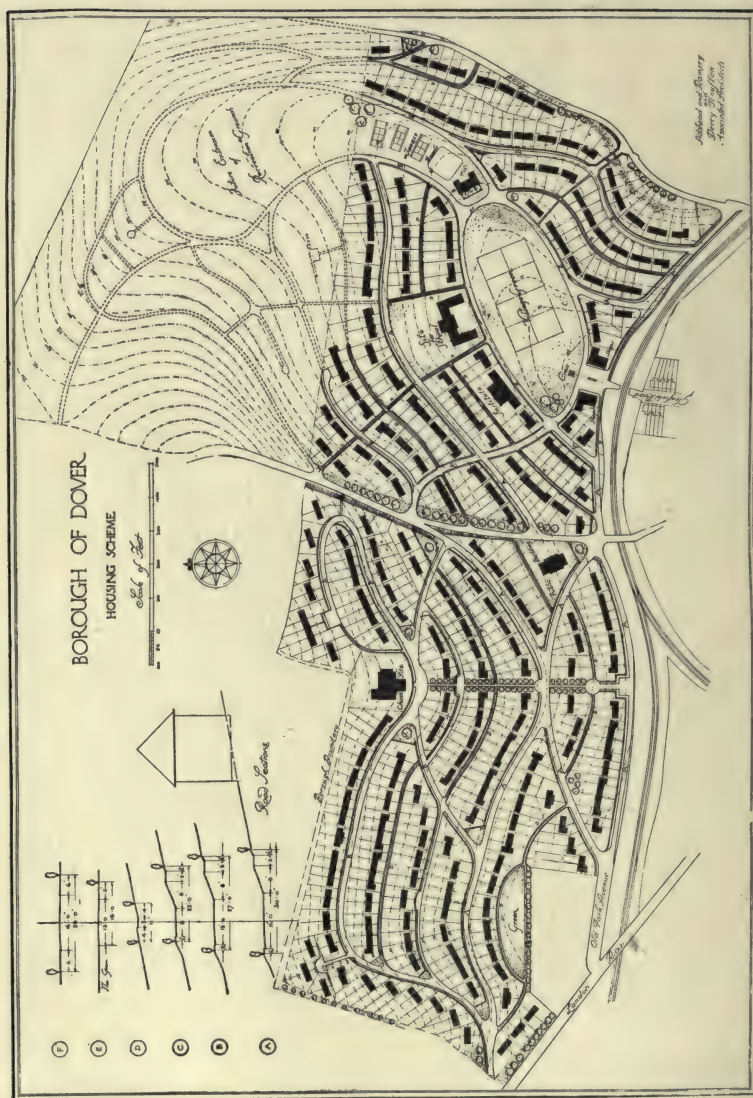


FIG. 63.—Housing Scheme at Dover. Adshead & Ramsey and Percy Houfton, Associated Architects.



FIG. 64.—Thornes Park Housing Scheme, Wakefield. Lay-out plan influenced by contours and desire to preserve existing trees. Barry Parker, Architect.

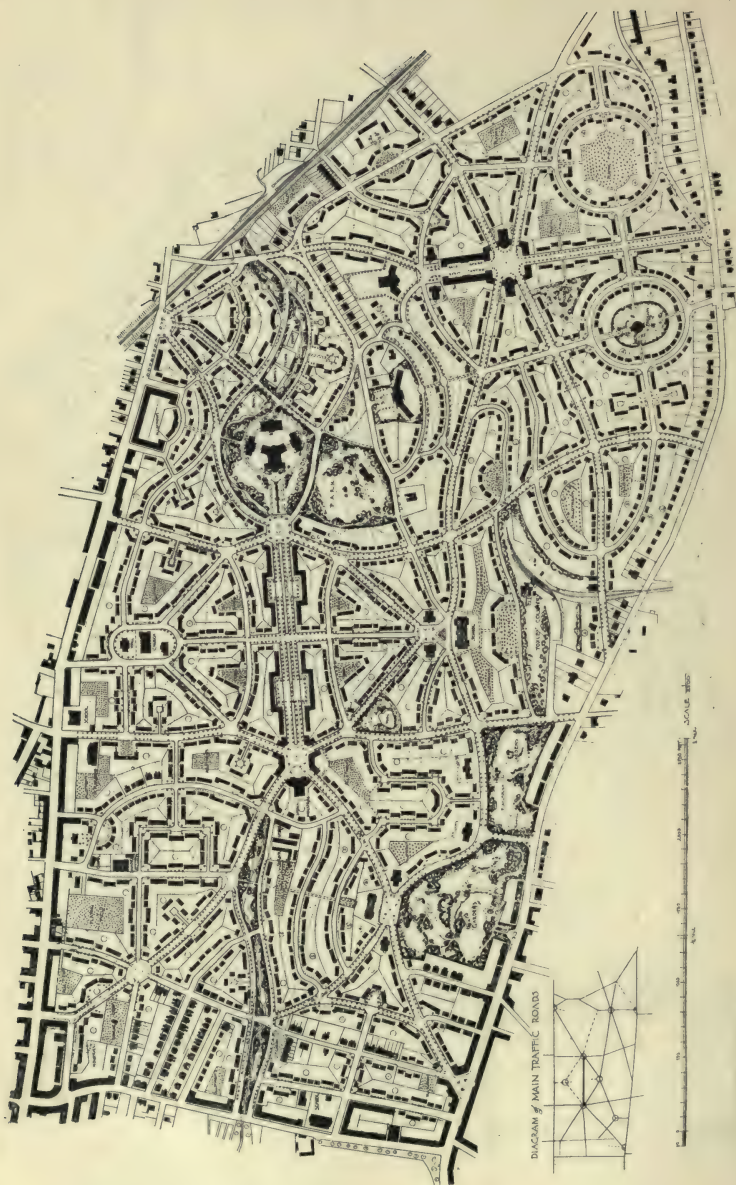


FIG. 65.—Lay-out of Shettleston and Tollcross Scheme, Glasgow. First premiated design by Longstreth Thompson, R. Dann & S. P. Taylor, Architects.

should be connected as conveniently as possible to the system of secondary roads which will be located where the best practicable gradients can be secured. In some cases, as at Abercarn (Lan Fâch) (Fig. 60), on the southern slope of the Stubbins scheme at Sheffield (Fig. 67) and at the Cwmneol site, Aberdare (Fig. 30), it is necessary,

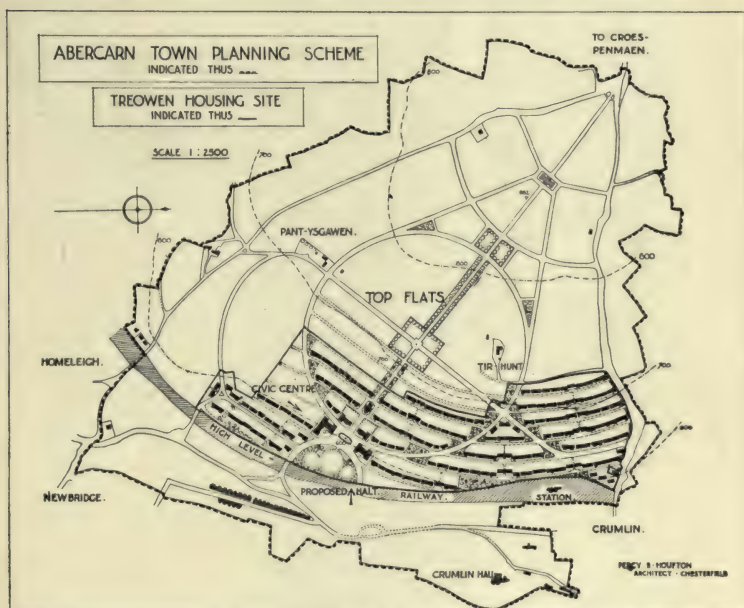


FIG. 66.—Treowen Housing Scheme, Abercarn. Percy B. Houfton, Architect.

Development of a steep hillside by means of narrow single-sided roads running parallel with the contours.

in order to obtain a practicable gradient, to zigzag the access roads up the hillside. This is a somewhat costly expedient both in road making and utilisation of land, and, where economy is one of the essential features of the development, it should be regarded as a last resort. The cost of laying out hilly sites is inevitably greater than in the case of fairly level sites, and it becomes all the more

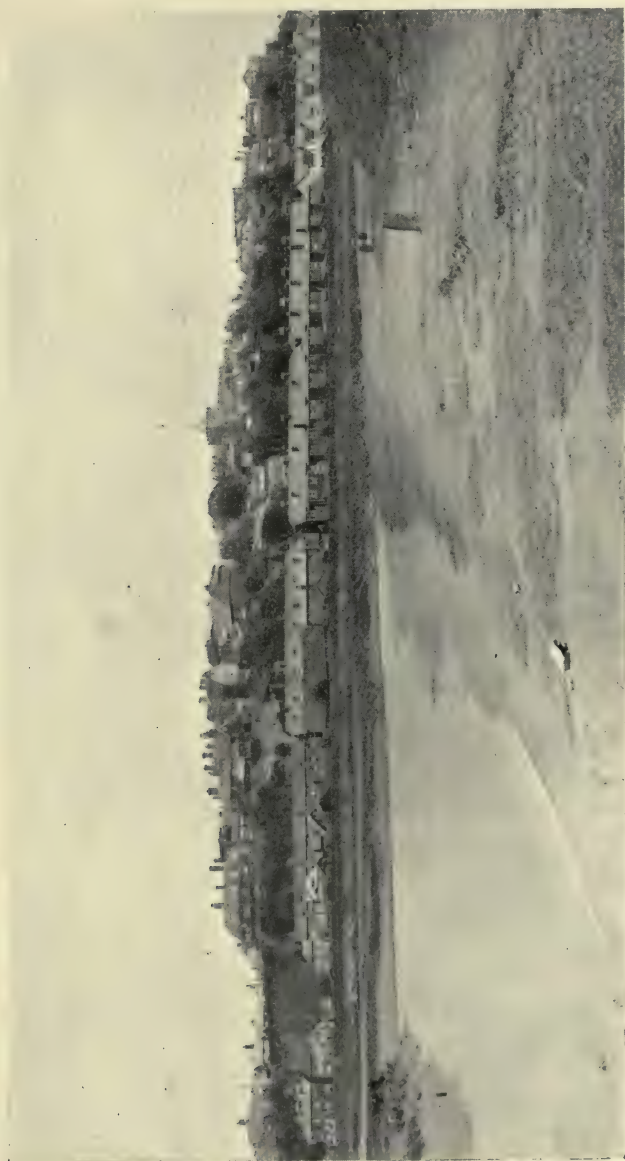


FIG. 68.—Rye.—“The pleasing effect of houses piling one above the other up the hillside.”

to the front of the houses is furnished by the footpath. The road works are thus reduced to the provision of one carriageway and two footways for the two rows of houses, which is equivalent to the normal double-sided road used in developing flat sites. Furthermore, by splitting up the road the cost of construction is greatly reduced, because, upon sidelong ground the amount of cutting and filling required is proportional to the square of the road width ; hence, as by halving the width the cost of the earthwork is quartered, it will be appreciated that very considerable advantages attach to any system that makes possible the use of narrow roads.

From the point of view of amenity, also, this method of development ensures, for houses situated upon a steep slope, a more open view and the possibility of a greater amount of sunlight than is obtainable in any other way ; while the general appearance of the scheme is immeasurably better. For, where houses are placed upon both sides of the roads, the prospect from below or across the valley is composed of the backs and backyards of the houses upon the lower side of the road. Whereas houses occupying the upper side only of narrow roads, present their fronts to the spectator in this position, while from above the backyards will be screened and not displayed by the gradient. Fig 68 illustrates the pleasing effect of houses piling one above the other up the hillside.

CHAPTER VII

WATER SUPPLY AND DRAINAGE

WATER SUPPLY FOR RURAL SCHEMES

AN adequate supply of pure water is an essential provision in connection with all housing schemes, and, as previously mentioned, no site should be chosen for such a purpose where this condition cannot satisfactorily be met. In the case of urban development, sites will generally be selected that can conveniently be served by the extension of an existing public supply, so that, as the quality of the water may be assumed to be satisfactory, the only points upon which assurance is required are that the necessary quantity can be supplied at the requisite pressure, and at a reasonable price. Where, however, the housing scheme is part of a project for the establishment of a new town, the installation of a complete system of water supply will be involved, and under these circumstances it is desirable to obtain the services of an expert in this highly technical and specialised branch of engineering. In rural districts, on the other hand, while public supplies are often not available, the problem is very much simpler, and some notes upon the subject may be of assistance to those who are called upon to tackle this question.

Quantity.—The average consumption of water for domestic purposes is usually assumed to be about 20 gallons per head per day. But this figure applies to urban conditions where the supply is continuous and laid on to every house, and the water-carriage system of sewage disposal is in operation. Hence, in considering the quantity which

will be required for small rural schemes where these facilities do not exist, this estimate will have to be considerably modified. In the absence of sewers, the employment of some form of earth-closet in place of water-closets will at once reduce the water consumption by several gallons per head per day, and where the supply is dependent upon the individual efforts of the family, and is not obtained by the mere turning on of a tap, the use of water for baths, and the less essential requirements, also tends to diminish. Thus it may be reckoned that an allowance of 15 gallons per head per day will in most cases suffice, and when investigating possible sources of supply, it should be established satisfactorily that, with suitable arrangements for storage, a sufficient quantity, calculated upon this basis, is available.

Quality.—For drinking purposes the water must be of good quality ; free from bacterial contamination or an excessive amount of minerals in solution, and without appreciable colour, odour, turbidity, or taste. It must be capable of passing the recognised tests of purity for human consumption, and samples should therefore be taken and subjected to expert analysis. The hardness of the water is also important both from the point of view of health and convenience in use. Where possible this should not exceed 8 degrees.

Sources of Supply.—*Springs.*—The sources from which the water supply for the small groups of houses at present under consideration will usually be obtained, comprise springs, wells, streams, and rain-water collected from the roofs of buildings. Where they are available, springs are in many ways the most satisfactory source. Of the two kinds, namely, surface and deep-seated springs, the latter are more satisfactory, as the water has been subjected to a greater degree of natural filtration, and being surrounded by an impervious stratum, it is less liable to surface contamination. With proper precautions against pollution,

however, the use of surface springs is quite permissible. An area immediately surrounding the spring should be fenced off, and the spring itself should either be enclosed within a tank or led into a tank near by as circumstances dictate. Such tanks are usually designed to contain about a week's supply; they are conveniently constructed of concrete, rendered on the inside with cement and backed with clay puddle; they should be covered in and ventilated and provided with an overflow. Where the spring rises at a higher level than the buildings, it will be possible to pipe the water from the tank and lead it by gravitation direct to taps in the houses, or, if the supply is not sufficiently abundant to justify this arrangement, to stand-pipes, with self-closing valves, serving several families. If a gravity supply is impracticable, the tank will have to be provided with a pump. It is usually desirable, as a precautionary measure, to filter the water used for drinking purposes either by means of pressure filters fitted to the taps or by jar filters, according to the circumstances.

Wells.—If the underground water, which issues in some places in the form of springs, has no natural outlet, it can be tapped artificially by sinking wells. As in the case of springs, the water may be derived from a porous subsoil overlying an impermeable stratum, in which case the well is described as “shallow”; or it may be taken from a water-bearing formation situated below a layer of impermeable material, when it is known as a “deep” well. The water from shallow wells is always open to suspicion, as it is peculiarly liable to contamination by soakage from defective drains, cesspools, or soakaways. It is better, therefore, to avoid the use of shallow wells, but if this is not possible, great care must be exercised in locating them as far as practicable from all likely sources of pollution, and at a higher level than any neighbouring cesspools.

The cheapest form of well is the Abyssinian tube, which consists of a number of lengths of strong wrought-iron pipe

screwed one to another as the whole tube is driven into the ground, and provided at the lower end with a length perforated to admit the water and furnished with a hardened steel spike to facilitate driving. In gravel, chalk, or other formation in which the flow of water is fairly free these wells yield a good supply. It is generally advisable, however, to sink a shaft. This should be steined, for a depth of from 6 to 10 feet in the case of a shallow well, and until the impermeable stratum is reached in that of a deep well, in solid brickwork, 9 inches thick, and laid in cement. Hard blue bricks specially moulded for the purpose are used for this lining, which is required in order to prevent the infiltration of subsoil water that may have come in contact with a source of pollution. Below this point it is usually necessary to continue the lining with the same bricks laid in open joint, which does not impede the flow of water but prevents the sides of the shaft from caving in. The well should be properly covered in and have a parapet at least 6 inches above the ground surface which should be paved with concrete to a distance of 4 or 5 feet all round the well in order to prevent surface washings finding their way into the water. It is preferable that the water should be raised by means of a pump, but if this is impracticable a winch and chain, with a bucket attached, should be provided, and on no account should the use of private buckets be allowed as this is a frequent cause of pollution. Under favourable conditions a wind pump or, where the size of the scheme justifies the expense, an oil engine can be used to raise the water to a service reservoir of sufficient elevation and capacity—say one week's supply—to render possible a gravitational system of distribution in pipes.

Streams.—Streams cannot be considered as reliable sources of water supply owing to the difficulty of keeping them free from pollution and the variability of their flow. If no other means of supply is readily available, water from a stream can, however, be utilised provided that it

is properly filtered before passing into the storage tanks, whence it gravitates or is pumped as in preceding cases. Where circumstances permit, the use of an automatic hydraulic ram is a convenient and economical method of raising water from a stream to the level of the storage tank.

Stored Rain-water.—It sometimes happens that it is impossible to obtain a sufficiency of good water at a reasonable cost by any of the foregoing methods, and it is then necessary to have recourse to the storage of rain-water either as a supplementary or, in some instances, the entire supply. The prejudice which exists against its use is probably caused by neglect of the elementary precautions required to be taken in its collection and storage. For in many respects rain-water is an ideal source of supply; it is pure and can be kept entirely free from the risk of pollution, and owing to its softness it is excellent for culinary purposes and washing; for drinking it is not so attractive as water from other sources, but if properly aerated it is quite palatable.

The roofs of the buildings form the usual catchment area, and should therefore be kept clean and free from vegetable growth; a slate covering is rather better for this purpose than one of tiles, and it is also less absorbent. If the water is to be used for drinking purposes the gutters and pipes should be of cast iron treated with Dr. Angus Smith's solution; lead or galvanised iron must be avoided, as the solvent action of the soft water is liable to cause lead and zinc poisoning. The water is collected in an underground storage tank, and, in order to prevent the first washings from the roofs and gutters finding their way into the tank, a separator is used which automatically diverts these to waste. The normal roof area of a cottage is not sufficient to provide an adequate supply of rain-water for all purposes, even when the bungalow type—having nearly double the area of the ordinary two-storey cottage—is

used. Hence, if the entire supply is dependent upon this source, it is necessary to construct a subsidiary collecting area. This may take the form of a concrete or other impervious surface upon which the rain either falls direct or through the filtering medium of turf, 12 inches thick, placed above the concrete upon a layer of special tiles ; in both cases the water is collected in channels and led to the storage tank. A gathering ground of this kind should be fenced in and isolated by a surrounding channel of suitable depth as a precaution against pollution. In calculating the area necessary to obtain the required quantity, it is usual to assume that 65 per cent. of the total rainfall can be collected from roofs or other impervious surfaces, if a separator is used, and 85 per cent. if the latter is dispensed with ; from a grass-covered surface as described above only 60 per cent. can be relied upon.

The storage tank should be designed to contain about 100 days' supply. It is usually better placed below ground both for convenience and because the temperature of the water is thereby kept lower and more uniform. It may be constructed of concrete—plain or reinforced—or of brick-work rendered in cement ; reinforced concrete is probably the most economical form of roof. The tank should be well ventilated and provided with a manhole for access and the necessary inlet, outlet, overflow, and washout pipes. Duplicate filters are desirable for cleaning purposes, and a clean water tank from which the supply is taken to the houses.

DRAINAGE

As in the case of water supply, so in regard to drainage, it will be possible in the majority of urban schemes to make use of facilities already existing in the town or district of which they will form part. The site planner is not usually concerned, therefore, with the arrangements necessary for the disposal of sewage upon a large scale, and his responsi-

bility is generally confined to the planning of an efficient and economical system of local drainage. Before, however, we consider this part of the subject, it will be convenient to deal briefly with the problems encountered in rural districts where no public sewers are available.

RURAL SCHEMES

Dry Method of Disposal.—The method adopted for the removal of waste matter from houses depends primarily upon the adequacy of the water supply. Unless there is a sufficient and regular supply delivered in pipes under pressure, the use of water-closets and the water-carriage method of disposal is not advisable, and the “conservancy” or “dry” system has to be employed. This involves the use of some form of earth-closet—privy middens on no account being allowed. The best form of earth-closet is that in which the receptacle consists of a pail, easily removable for purposes of emptying and disinfecting, and provided with a supply of dry earth for deodorising the contents; the earth can be applied by means of a hand scoop, but is preferably discharged into the pail automatically from a hopper situated at the back of the seat and connected to it by a series of levers. To be effective the earth should be dry and of a loamy character, as it is then a much better deodorant than when damp or sandy, and also has a greater manurial value. Under ordinary circumstances it is usual for the occupants of the houses to empty the pails and dig the contents into the gardens, but this should not be permitted in close proximity to a well; in such a case arrangements should be made for the regular clearance of the receptacles and the carting away and distribution of the contents in a field.

Liquid Wastes.—The use of earth-closets and the dry method of disposal does not, however, completely solve the problem of drainage even when circumstances preclude

the use of a water-carriage system. There still remains a certain amount of liquid refuse in the form of slops and sink water, which has to be got rid of. Rain-water from the roofs, in so far as it is not collected and stored, will also have to be dealt with, and even when it is required for use, some provision will have to be made for the first washings from the roofs and the overflow from the tanks. It is usually an easy matter to lead the surplus rain-water either to butts for garden purposes, to soakaway pits, or to a neighbouring ditch, but the foul water from sinks

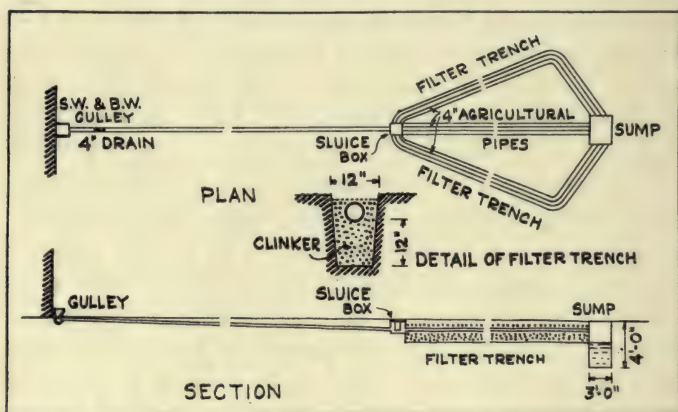


FIG. 69.—Arrangement recommended by Ministry of Agriculture for disposal of bath and sink wastes in rural areas where sewers are not available.

containing a good deal of putrescible matter requires more careful treatment. Where the soil is sufficiently porous, probably the best method of dealing with this effluent is either that of sub-drainage by means of tile drains laid in rubble about 6 inches below the surface, or, alternatively, that advocated by the Ministry of Agriculture (see Fig. 69). In the latter system the waste pipes from the bath and sink discharge into a trapped gully outside the house, from which a 4-inch stoneware drain carries the liquid to a system of filter trenches controlled by means of a sluice box. If the fall of the ground is insufficient for the effluent to drain

away naturally, the latter is collected in a sump, whence it is either pumped or baled as soon as the water-level reaches that of the filter trenches. In the case of a clay subsoil where irrigation on this principle is impracticable, it will be necessary either to construct filter beds capable of producing an effluent of sufficient purity for discharge into a ditch or watercourse, or, failing the requisite fall and facilities for discharge, to provide cesspools. As both of these methods are employed, in addition, for the disposal of water-borne sewage in small quantities, it will be convenient to consider them in this connection at the same time.

Water-carriage System.—If the supply of water is adequate and regular, it is generally desirable to adopt the water-carriage system of sewage disposal, even when there is no existing sewerage scheme with which to connect. Under these circumstances we have to deal with the sewage from water-closets in addition to the bath and sink wastes. Where the houses are scattered in small groups and the quantity of sewage to be treated is consequently small, it may often be disposed of, if the levels and the nature of the soil permit, by surface irrigation of land in the vicinity. In such cases a small tank or catch-pit, with a screen or scum-board, should be provided, the solids removed and buried, and the irrigation regularly attended to; subsoil irrigation or soakaway pits, though sometimes used, cannot be considered satisfactory. A more efficient method, referred to in the last paragraph, is the construction of a small filtration plant. This consists essentially of a detritus chamber into which the sewage is first introduced to allow grit or other mineral matters to settle; a septic tank, where it is subject to the liquefying or gasifying action of anaërobic organisms; and filter beds, composed of hard furnace clinker, coke breeze, or other suitable material, where the aërobic or oxidising process takes place—producing an effluent which can safely be discharged into an adjoining stream. The sludge from the tank has to be

removed periodically and dug into the gardens. Provided that a suitable site is available, having sufficient fall to a watercourse within reasonable distance, a small plant of this character is relatively inexpensive to construct, requires a minimum of attention, and is highly efficient. There will, however, be circumstances in which neither surface irrigation nor filtration is feasible and in such cases it will be necessary to deal with the sewage by means of cesspools. These must be of water-tight construction properly covered in and provided with ventilators; the inlet should be trapped and there should be no overflow. They should be placed not less than 50 feet from a house, and at least 60 feet from any well. Arrangements have also to be made for their periodical emptying and the disposal of the contents in an inoffensive manner.

URBAN SCHEMES

Existing Sewerage System.—The drainage of the houses in urban schemes, where it is possible to connect to an existing public sewer, is not complicated by the problems of subsequent treatment, but consists simply of the arrangement of a system of house drains and sewers by which the surface water and sewage is conveyed to the point of discharge as expeditiously and economically as possible. In planning such a system, it will be necessary to comply with the method of sewerage already in operation in the district. This may be either the *Combined* system, in which both sewage and surface water are taken into one sewer; the *Separate* system, in which sewage and surface water are taken into separate sewers; or the *Partially Separate*¹ system, in which all the house drainage is taken

¹ This term is also used to denote a system in which surface water from the roads and fronts of the houses is taken into the surface-water sewer, while that from the backs of the houses is allowed to discharge into the foul sewer.

into the foul sewer, but a separate sewer is used for the surface water from the roads. The effect of these different systems upon the arrangement of the house drains will be discussed in a later paragraph; but, apart from the modifications implied in the definitions of the several methods, the general principles upon which the scheme of sewers is laid down are to all intents and purposes the same in all three cases.

Determination of Main Lines of Drainage.—Wherever possible, the sewers should be designed to secure a gravitational flow throughout the entire system to the point of discharge. It is therefore desirable that the lines of natural drainage should be followed as closely as practicable, and, as the sewers are most conveniently situated in the roads, it is important that the lay-out of the latter should not finally be settled until the main lines of the sewerage system have been determined. Full advantage can then be taken of the topography of the site to secure good gradients and moderate depths; moreover, land which cannot readily be drained will be discovered and reserved for other uses before any steps are taken to lay it out for building purposes.

Provision for Future Extension.—In fixing the sizes and depths of the sewers, consideration must be given to the requirements of possible future extension as well as to those of the houses comprised in the immediate scheme. Subject to such allowance as it is desirable to make on this account, however, the depth should not be greater than is sufficient adequately to drain the houses; in the development of areas where it is not intended to construct cellars, a minimum depth of 5 feet can generally be adopted.

Location of Sewers.—It is usual to place the sewers under the carriageway in the roads, where they are equally accessible to the houses upon both sides. This position is not ideal, because of the expense and dislocation of traffic involved, both when new house connections are put in, and also in the event of it being necessary to open up the

sewers for repair. The first of these drawbacks disappears in the case of a housing scheme where it is possible to lay the necessary branches when the sewer is originally constructed, and it can to some extent be avoided in other cases by putting in branches in anticipation of the future requirements. But the second is a more difficult problem. In curved streets the sewers are necessarily laid in chords which cut right across both carriageways and footways, while in straight roads a location under the footpath or grass margin is frequently prevented by the danger of damage from the roots of trees. For roads having a width of 60 feet or more, however, the possibility of effecting economy by laying duplicate sewers under the footpaths on both sides of the road should be considered. This will depend upon the saving effected in the length of house connections and the possible reduction in the depth of the sewer, and can readily be estimated for any given case. In hilly districts, development by means of contour roads, with houses on both sides of them, introduces a new element into the problem, since, if a single sewer is laid in the road, it must be given a much greater depth, in order to drain the houses on the lower side, than is required for those on the upper side. In such a case it is usually less expensive to reduce the depth of the sewer in the road and lay a duplicate sewer at the back of the lower houses. The use of a common drain discharging at intervals into the sewer in the road below, is an even better arrangement ; and as this expedient is useful, not only in this case but in many others, it will be desirable to consider its general application.

Arrangement of House Drains.—Hitherto it has been customary to require that each house should have an individual connection to the public sewers, and so long as this requirement is enforced there is little opportunity of devising any more economical arrangement than that the drains should be as short and direct as circumstances allow. But where the use of sectional drainage is permitted it is

necessary to consider both the planning of the house and the disposition of the drains with some care, since arrangements which may be economical with one system of sewerage may not prove to be so with another. Thus, if the combined system is in use, little advantage is gained by grouping all the apartments requiring foul water connections on one side of the house, as, in order to take the rain water from the roofs, drains, which are also capable of taking foul water, will be required on both sides of the building. In the case of the Separate or Partially Separate systems, on the other hand, very considerable economy is secured by such an arrangement, as it is then possible to dispense altogether with a soil drain at the front of the house.

Economy of Sectional Drainage.— But, whichever system of sewerage is in operation, there can be no doubt that Sectional Drainage for small houses is more economical, and not less efficient, than the older method of separate connections. Great stress was laid upon this point by the Tudor Walters Committee. In their report they say: "Considerable economy could be effected in connection with the drainage of small dwellings by the general adoption of the system of the Common drain, or Sectional Drainage; this consists of using a common drain to collect the drainage from a number of houses, and to deliver at one point into the main sewer, instead of requiring each house to have its drainage system separately connected; the latter system involves separate disconnecting traps, manholes, and ventilating arrangements for each house with a separate connection cut across the road to the sewer. Where there is a duplicate system two connections, one to the sewer and the other to the rain-water drain, have to be provided for each house. The cost of these numerous connections is increased where the roads are wide or where the houses are set back from the road in a manner which for other reasons is most desirable. The saving in cost by the adoption of the common drain is substantial if only the

works within the curtilage of the houses themselves are considered ; but if the cost of cutting up the crust of the roadway after it is made and of making good the damage resulting from settlement and reinstatement of such connections is also taken into account, the economy which may be effected is very considerable. . . . In addition to the economies which result from the combined drain, the actual drainage from each house may be considerably simplified ; an excessive number of manholes is sometimes required in places where rodding eyes would answer all purposes ; also the collection of the branches from bath and sink gullies into the branch from the soil drain will save length in branch drains and reduce the number of connections with the common drains ; moreover, a useful flush is provided for the soil drain by this means."

Figs. 70 and 71 will give some idea of the relative expense of the two methods under varying conditions of lay-out, (a) where the combined and (b) where the separate system of sewerage is in force. It will be observed from the diagrams, that in each case the use of "sectional drainage" results in a considerable saving both in the actual length of pipe and also in the number of manholes, intercepting chambers, etc., required. The economy moreover, is greater when the houses are set back from the general frontage line or grouped in culs-de-sac, thus clearly demonstrating the especial suitability of employing this system in connection with the type of development which a reduction in building density and a greater attention to amenity have brought into being.

Conditions requisite to Efficient Arrangement.—The conditions which should be satisfied by a system of sectional drainage in order to secure an efficient and economical arrangement, were the subject of the following recommendations of the Tudor Walters Committee which have since been incorporated in the "Manual for the preparation of State Aided Housing Schemes."

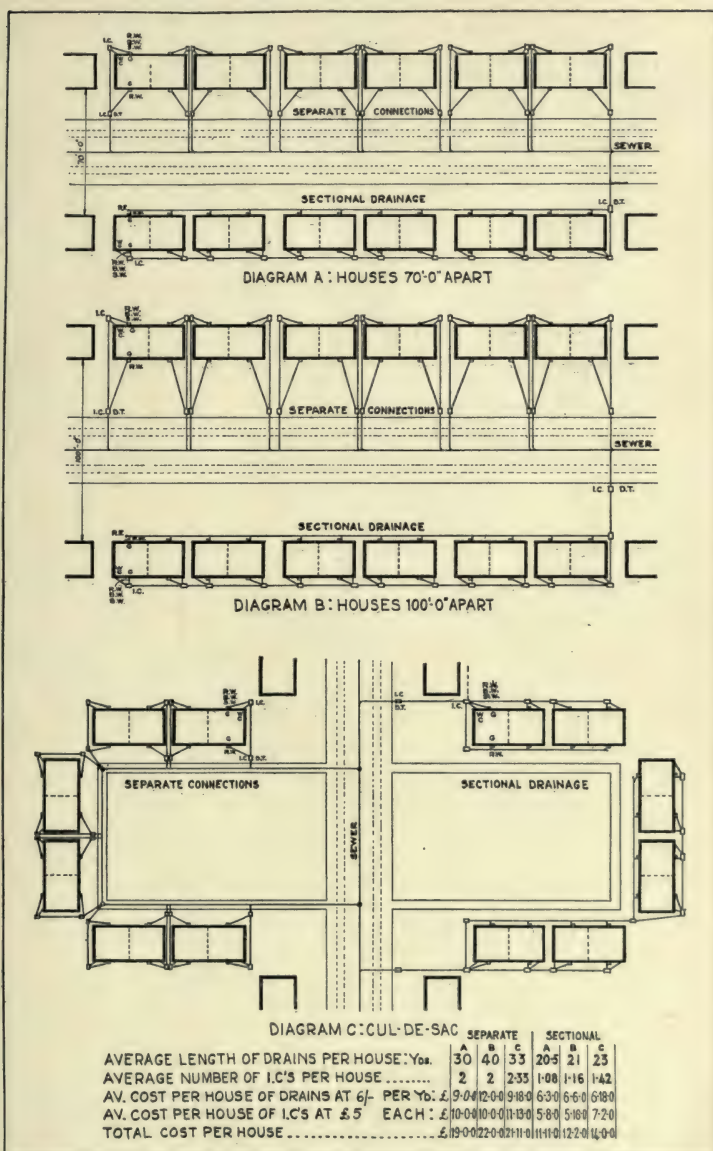


FIG. 70.—Diagram showing comparative cost of using Separate House Connections or Sectional Drainage where the Combined Sewerage System is in operation.

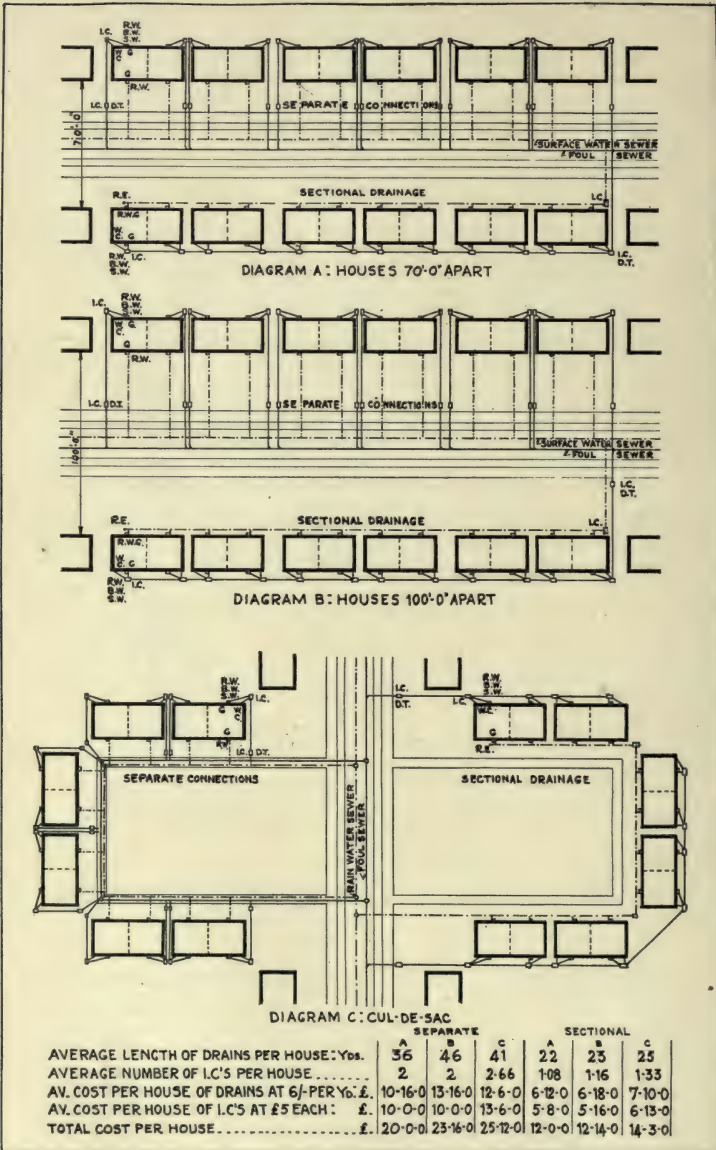


FIG. 71.—Diagram showing comparative cost of using Separate House Connections or Sectional Drainage where the *Separate* Sewerage System is in operation.

- “ 1. One connection to the sewer to serve a section generally not exceeding 14 dwellings.
- “ 2. An intercepting trap and manhole to be placed on the common drain within the section drained as near as convenient to the junction of the sewer.
- “ 3. The system to be ventilated by means of vent pipes as follows :
 - “ (a) From the manhole containing the intercepting trap.
 - “ (b) At the head of each common drain.
 - “ (c) Each separate block of dwellings to have a vent pipe at or near the highest point of the common drain adjoining : the vent to be carried up clear of the eaves of the building.

“ NOTE.—Where blocks of dwellings have W.C.s on the first floor connected to soil pipes, the soil pipes should be carried up as vent pipes in the usual way ; in that case the vent pipes previously mentioned for each separate block could be omitted.

- “ 4. A manhole to be provided where two common drains form a junction.
- “ 5. Inspection chambers or rodding eyes to be so placed that no length of drain exceeding 100 feet in length in a straight line is without means of clearing or examination. Rodding eyes to be provided also where a change in the direction of the drain or a branch connection renders this desirable.
- “ 6. All pipe connections to be by oblique bends or easy curves.
- “ 7. All connections from the dwelling to be brought into the soil drain as near the building as practicable, so that as few connections as possible are required to the common drain.”

As condition 5 allows rather much latitude for individual interpretation as to the position in which inspection chambers and rodding eyes should respectively be used, it is desirable to amplify this somewhat, and it is therefore suggested that, in addition to the position specified in 4, inspection chambers should be provided :

(a) Where there is a change of direction enclosing an angle of *less* than 135° .

(b) Where there is a change of gradient.

(c) Where there is a change of diameter.

And that rodding eyes should be used at—

(d) The head of each common drain, and

(e) All changes of direction enclosing an angle *greater* than 135° .

It might be added that pipes of 6 inches diameter should be used for common drains up to the maximum of 14 houses, though, if not more than 4 houses are connected to it, a 4-inch pipe will be sufficient ; except under special circumstances, however, the saving effected by the use of the smaller diameter is more than counterbalanced by the cost of the inspection chamber required at the point of change, hence it is generally more economical to maintain a uniform size of 6 inches throughout the length. The usual practice in the matter of gradients is to aim at a fall of 1 in 60 for 6-inch pipes and 1 in 40 for 4-inch pipes, but if circumstances render it necessary, these can be reduced without serious objection.

Responsibility for Maintenance.—Although the method of sectional drainage has been employed almost universally in connection with the Government Housing Scheme, its general adoption has undoubtedly been retarded by the legal position, which is such that the responsibility for maintaining the common drain as a sewer is liable to be placed upon the Local Authority. Endless controversy and considerable litigation have arisen on account of the difficulty of finding satisfactory definitions of these two

terms. The chief difference between a sewer and a drain is that the Sanitary Authority is responsible for the maintenance of the former, and the Owner for the maintenance of the latter. Hence, in municipal housing schemes, where the Local Authority is at the same time the Sanitary Authority and the Owner of the houses, this difference disappears and the advantages of common drainage can be secured without unfair apportionment of maintenance charges ; this explains the universal adoption of the system under the Government Housing Scheme. But in order that the same facilities should be available to the private Owner, Public Utility Society, or Development Company, it is very desirable that the legal position should be reconsidered. As the advantage derived from the use of common drains is almost entirely for the benefit of the Owners, it would be reasonable to place upon the latter the responsibility for maintaining them, and the following distinction between drains and sewers suggested by the Tudor Walters Committee would appear to meet the case very fairly :

- “(a) A *Drain*, which would mean a drain to which only one building is connected, maintained by the owner of the drain.
- (b) A *Common Drain*, being a drain to which more than one dwelling is connected, maintained by the owner or owners of all the dwellings in proportions determined either by rateable value, previous agreement, or otherwise ; and
- (c) A *Sewer*, being a public sewer repairable by the Sanitary Authority.”

If such a classification were to be adopted, and the appropriate clauses of the Public Health Acts amended accordingly, it would remove the only serious obstacle to the general employment of sectional drainage, and thus facilitate the economical solution of one of the chief problems of open development.

CHAPTER VIII

OPEN SPACES, GARDENS, AND ALLOTMENTS

OPEN SPACES

The Value of a Co-ordinated Park System.—The provision of adequate Open Space is a fundamental requirement in any well-considered scheme of development. It is necessary in order to secure the amenity of surroundings that plays such an important part in the mental outlook and civic pride of the citizens ; it is essential in order to provide the lungs that maintain the healthiness of the city ; and it is indispensable to the enjoyment of open-air recreation. Many of our towns are fortunate in the possession of common lands which have escaped the fate of enclosure that so frequently overtook such property during the last century, and of fine parks acquired by the enterprise of the authorities or the munificence of individual donors. But these have frequently not attained to their proper measure of success owing to haphazard distribution, or lack of accessibility. In order to be really effective, open spaces should form part of a connected scheme in which the needs of the various districts of the town are satisfied in an appropriate manner, and the requisite degree of accessibility is assured.

Nature of Requirements.—A comprehensive park system includes open spaces fulfilling several different functions. In the centre of the town the trim lawns and bright flowers of the small public gardens provide welcome oases in the desert of hot, dusty pavements. Less formal parks where the workers can take their lunch or indulge in

the scratch game of football or cricket that usually occupies the spare minutes of the dinner hour, are conveniently situated near the industrial quarter. On the outskirts of the town large natural reserves like Epping Forest near London, the Lickey hills at Birmingham, and the Addington hills at Croydon—to mention three at random—are deservedly popular with the large body of town dwellers who, without the time or the means to go far afield, are glad of the opportunity to refresh themselves by frequent visits to the country. The eager exodus of, apparently, every family in Vienna for the Sunday excursion into the wooded hills that surround that city, is a striking illustration of the value of reserving these stretches of unspoilt country upon the margin of a thickly populated district. But the provision of open spaces of this character rarely comes within the province of the planner of a housing site. Occasionally, as in the Hawksworth Wood and Middleton schemes at Leeds (see Figs. 20 and 9), a favourable opportunity occurs of acquiring such an area in connection with the land to be developed for housing purposes, but even under these circumstances the park is primarily to satisfy the needs of the town and cannot be considered as part of the housing project. We are more concerned, therefore, in setting apart land for such requirements as cricket and football grounds, tennis courts and bowling greens, playgrounds for small children and allotment gardens.

Allowable Area.—The extent of the provision which may reasonably be made for open spaces in a housing project, will depend upon the cost of the land, the size and character of the scheme, and the nature of its surroundings. For the type of development under consideration, however, it is usually desirable to reserve approximately 10 per cent. of the total area of the site. Knowing the space available, it will then be possible to make use of it in the most suitable manner, having regard to the needs of the case and the nature of the ground.

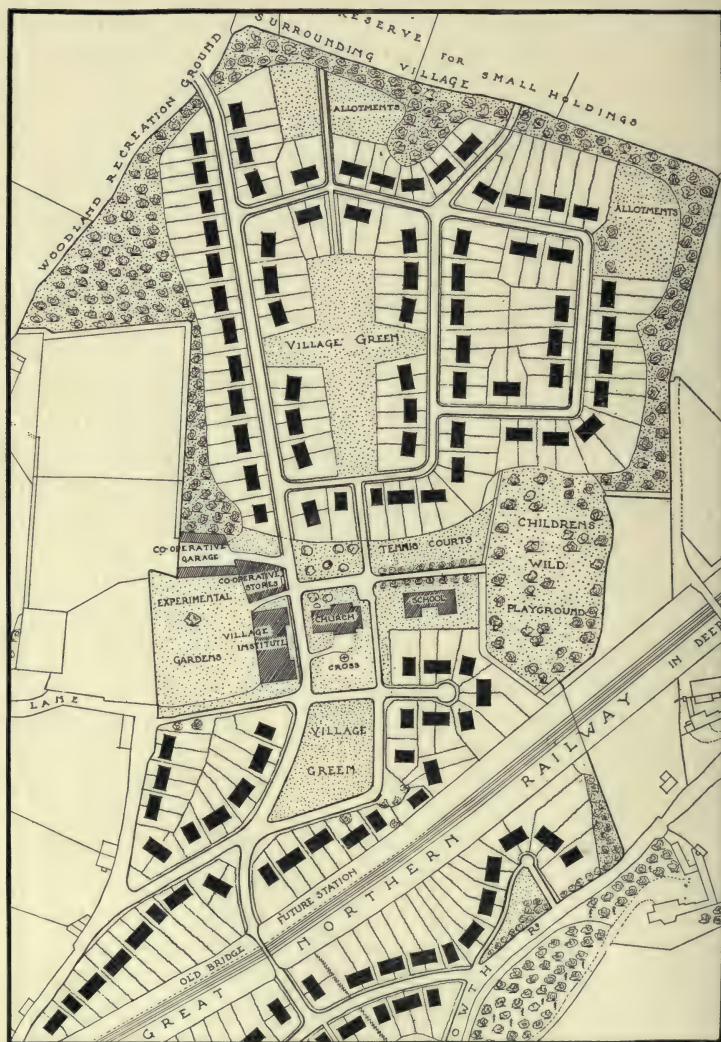


FIG. 72.—Lay-out plan of Killestre Housing Scheme near Dublin ;
note reservation of woodland belt round village.

Cricket and Football Grounds.—It is usually desirable in connection with the larger schemes, to provide at least one open space sufficiently level and of adequate size to accommodate both cricket and football grounds. A convenient size for a cricket field is 170 yards by 130 yards, and it will be found that, reserving for the pitch a strip down the centre 30 yards wide, there will be ample room for two football or hockey grounds as well. The area occupied in this arrangement amounts to 5 acres, which, upon the 10 per cent. basis, implies a housing scheme having a total area of at least 50 acres and in most cases considerably more, as it would not usually be sound practice to devote the whole of the available open space to this particular use. Even in the smaller schemes, however, if the village green is not only a playground, but is also a decorative feature of the village, as in the Dover Scheme, Fig. 63, there is little to be said against such an arrangement.

Lawn Tennis Courts.—Much, however, depends upon local preference in the matter of games. The phenomenal increase in the popularity of lawn tennis, for example, renders the provision of space for tennis courts almost essential. Occupying comparatively little room and providing a vigorous form of recreation to a large number of people in a short time, tennis is a particularly suitable game for the present-day intensive mode of life. Provided the land is reasonably level, or can be levelled without undue expense, almost any site will serve for tennis courts, though it is a great advantage if they can be arranged with the long axis running north and south, as play usually takes place in the afternoon and evening, when, with this orientation, the sun will shine across the court and not into the players' eyes. Small spaces at the backs of the houses or the enclosures of road-bays can often profitably be used for tennis courts for the joint use of the neighbouring residents.

Combined Facilities for several forms of Recreation.—Another plan that has much to recommend it, is to combine



FIG. 73.—Lay-out plan of Housing Scheme at Lemington-on-Tyne.
Harvey & Wicks and Adshead & Ramsey, Architects.

tennis courts with the provision for other games, children's playgrounds, and so forth, and arrange them in one comprehensive open space. This plan has been followed very successfully in the Lemington-on-Tyne Scheme (Fig. 73),

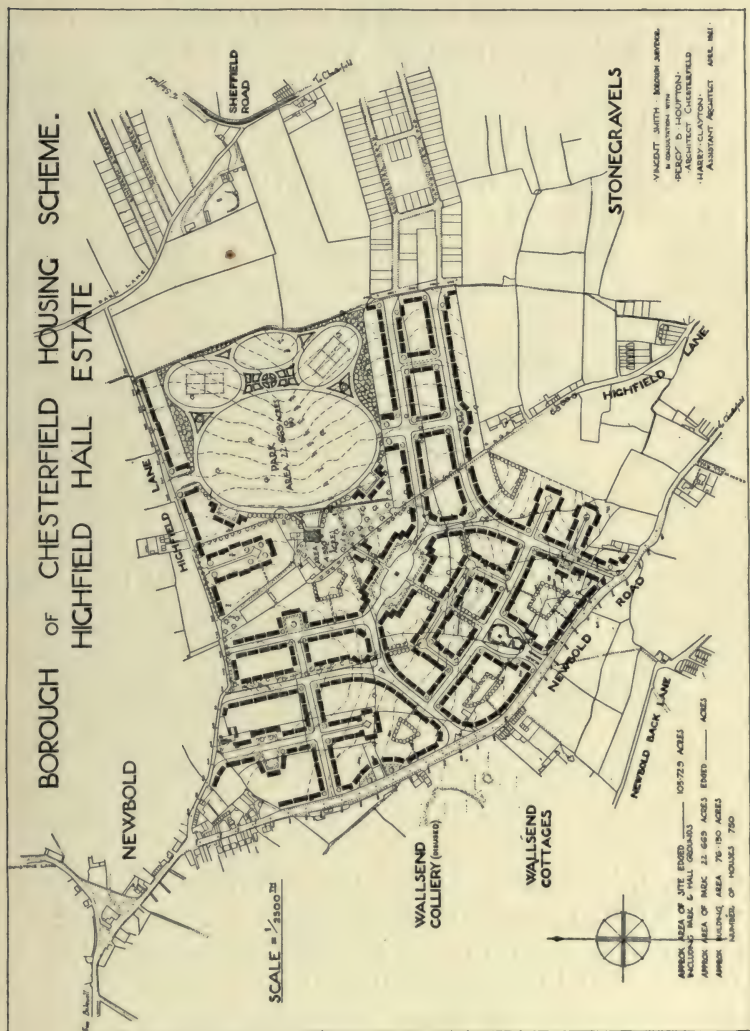


FIG. 74.—Lay-out of Highfield Hall Estate, Chesterfield.
Percy B. Houton, Architect.

where the arrangement is rendered even more complete by the inclusion of the school and its playgrounds. Other examples of grouped treatment will be noticed in the Chesterfield Highfield Hall plan (Fig. 74), and in the extensive park strip running through the Walton-Clubmoor development at Liverpool. The advantages of such a combination were touched upon in Chapter IV. in connection with the choice of school sites, and the principle of placing schools

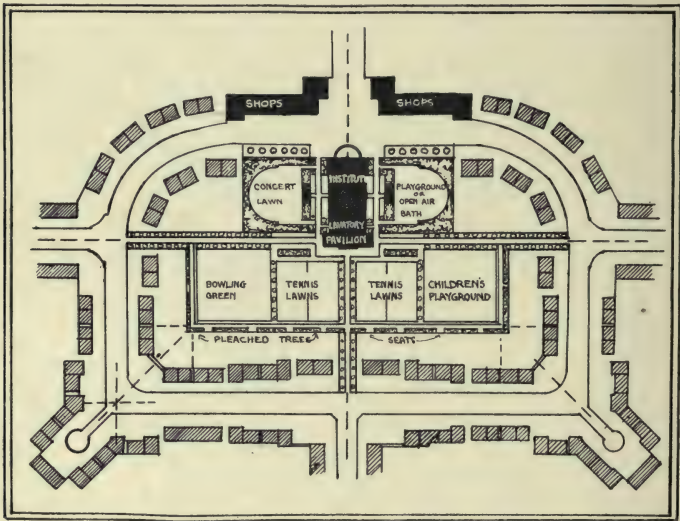


FIG. 75.—Suggested treatment of small Recreation Ground.
Reginald Dann, Architect.

in a position where they are able to enjoy the fresher air and increased playing facilities of an adjacent open space is one that might well be adopted more frequently. A further merit in grouping different forms of recreation in one place, especially when the activities of varying ages are catered for, is that it is often a great convenience for the elder members of a family to be able—while indulging in their own sport—to keep an eye on the children playing near-by. This applies particularly to such games as tennis

and bowls, and is equally appropriate in the case of allotment gardens where a small area devoted to a sandpit, swing, and other juvenile delights will keep the children perfectly happy and afford the adults greater freedom to do their work. An example of the latter arrangement is illustrated in the plan for the Walker Housing Estate at Newcastle-on-Tyne. The location of the local Club or Institute in connection with the Recreation Ground is also both effective and economical. Accommodation for dressing-rooms and lavatories, which would otherwise have to be provided in separate pavilions, can readily be included in the Club building, while the surroundings of the latter are at the same time greatly improved. Fig. 75, reproduced from an article upon "The Treatment of Public Gardens and Open Spaces," contributed to *Housing* by Mr. Reginald Dann, is an interesting example of the treatment of a Recreation Ground on these lines.

Children's Playgrounds.—Apart from the playgrounds attached to school buildings, and these are not usually available during leisure hours, remarkably few facilities for children's recreation exist in the majority of our towns. Quite often the street is the only playground; but even when other places are available they are frequently of such a depressing character, or involve such long journeys for small legs, that a large proportion of the children still prefer the pavement and the gutter. The street, also, has a certain independent popularity of its own, which is due partly to its convenient situation just outside the door, partly to the fact that it is the easiest and most natural meeting place, and partly to the suitability of its surface for many juvenile games. It must be recognised, however, that as playgrounds the streets are dangerous, dirty, and, in fact, altogether unsatisfactory. But certain lessons may be learned from them and applied to the scheme of children's playgrounds which must be furnished to take their place. Thus, accessibility is of primary importance, and a distance

of half a mile should be considered as the maximum radius of the area they are designed to serve. It should, furthermore, be possible for the children to reach the playgrounds without having to negotiate dangerous street crossings, and from this point of view the odd spaces in the interior of the blocks, which are not required for subdivision into gardens and are not large enough for tennis courts and allotments, constitute admirable sites. The size and equipment of the playgrounds will vary according to the ages of the children and the use for which they are intended. For the younger ones, quite small plots, provided with such simple apparatus as a sandpit, a swing, and a shallow pond for paddling and boat sailing, are perfectly adequate. More space will be required for ball games, and for this purpose it will usually be better to combine the playground with a general recreation ground, as suggested in the last paragraph. Circumstances will dictate the degree to which it is desirable to drain, level, or otherwise make the site more suitable for its purpose. It is important that the surface should be as dry as possible and free from mud; and where, as in small areas, the play is highly concentrated, it is advisable to put down gravel or tar paving laid to a slight fall from the centre; for the larger areas, grass—if properly looked after—is pleasanter and less dangerous to fall upon. It is desirable that shelters, preferably with lavatory accommodation, should be provided, and in connection with some of the central playgrounds a covered playroom for use in wet or cold weather would be a great boon, both to the children and to those responsible for looking after them.

Decorative Function of Open Spaces.—It may possibly have occurred to the reader that too much emphasis has been laid upon the utilitarian aspect of the open spaces, and that too little attention has been paid to their decorative function. But there need be no apprehension on this account, for utility, far from being subversive of

beauty, is one of its chief attributes. This contention, in so far as it relates to the present subject, receives strong support in the following quotation from Mr. Dann's article to which reference has already been made. He says, "Under ordinary circumstances the land available for public gardens and open spaces will not allow much reservation of ground for purely decorative purposes, except in the case of areas of particular natural beauty, or in order to preserve the amenities of the neighbourhood. This does not necessarily mean that our housing schemes will be unattractive, for we are learning, in the case of public gardens as in so many other things, that beauty is not a quality readily to be superimposed for its own sake, but is usually found associated with anything that most effectually serves the purpose for which it is required."

"Public Gardens designed to serve the community as recreative and social centres are more likely to achieve beauty than the great majority of existing parks and gardens, where much space is often wasted in deliberate attempts to impose it. What is more beautiful than a simple square of perfect turf surrounded by a neat hedge and path with perhaps a border of hardy flowers or rows of pleached limes or mop-headed acacias, with possibly seats and a small pavilion. Such a lawn has a utilitarian purpose, but its utility and its beauty would be destroyed if it were sprinkled with trees and shrubs even though these were beautiful in themselves."

"Our public gardens should, therefore, be planned for 'intensive' use on direct and simple lines, with lawns for tennis and bowls, playing fields and children's playgrounds. They should be planned to occupy back land in order not to take up valuable frontages, and they should be arranged and laid out with a view to facility of oversight and economy of upkeep."

Open Spaces and the Occupation of Road Frontage.—The question of the frontage occupied is a very important

one. Road-making is an expensive item, and economy, without which, indeed, housing development is financially impossible, demands that no greater frontage should be occupied than is reasonably necessary, having regard to the character and purpose of the particular open space. Thus, beyond adequate means of access, open spaces such as allotment gardens, which have little or no decorative value, but on the contrary are apt to be rather untidy, do not require any road frontage at all, and are much more suitably placed upon land at the back of the houses. Many areas devoted solely to playing-fields may similarly be accommodated, although, as some of the foregoing illustrations demonstrate, it is possible to make of them a distinctly decorative feature. But even where the object of the open space is partly or mainly decorative, it is not by any means necessary that it should be surrounded by roads. In the case of the village green, which forms the social centre of the neighbourhood, the encircling road is an essential part of the arrangement, and cannot be dispensed with. But, ordinarily, it is quite possible to obtain the desired effect without incurring this expense. The plan illustrated in Fig. 75 is an excellent example of how a public garden can be treated in such a way as to fulfil its decorative function in the street picture and at the same time occupy very little road frontage. On a larger scale, a somewhat similar treatment has been used in the case of the park shown upon the plan of the Chesterfield Highfield Hall Estate (Fig. 74), while amongst established instances, the Rosenau at Nürnberg is particularly pleasing. It must not be assumed that the stress which is here laid upon the desirability of limiting the frontage occupied by open spaces indicates any lack of appreciation of the beauty added to a street by an uninterrupted view over a park, so strikingly exemplified in the case of Birdcage Walk and St. James's Park. On the contrary, no one will dispute that where such treatment is possible it is extremely

effective, but methods which are perfectly justifiable in planning the principal features of large towns are not necessarily applicable to the development of housing estates, where the strictest economy, consistent with



FIG. 76.—Diagram showing Open Space entirely surrounded by roads.

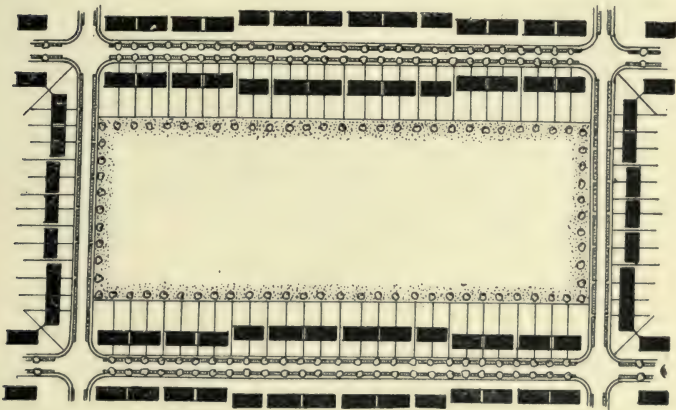


FIG. 77. Diagram showing arrangement by which the Open Space occupies road frontage on two sides only.

reasonable amenity, is absolutely essential. In order to demonstrate the effect upon expenditure of different ways of treating an open space in regard to the frontage occupied, the three diagrams in Figs. 76, 77, and 78 are reproduced from an article in *Housing*. For purposes of comparison,

it was assumed that half the cost of the road upon which the open space abuts, amounted, with half the cost of the sewers, to £1 per lineal foot. It is possible that where a light carriageway only is required and the footpath on the side adjacent to the open space can be dispensed with, the cost may be somewhat less, but in most cases it is likely to be more, so that the results err, probably, in the direction of an under-estimate. An open space having an area of 5·646 acres was taken in each example. In Fig. 76 it is

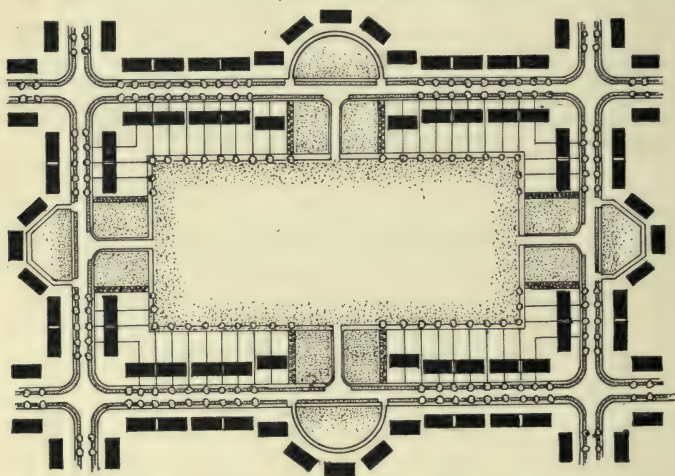


FIG. 78.—Diagram showing how an Open Space can be arranged to occupy a minimum of road frontage without sacrificing its decorative value to any great extent.

shown entirely surrounded by roads, the half cost of which would be, upon the basis adopted, £2260, or exactly double the value of the land occupied by the open space reckoned at £200 per acre.¹ In Fig. 77 the two longer sides of the park abut on back gardens, and only the short ends front on to a road. By this arrangement the road costs are reduced to £600. In Fig. 78 the open space is placed

¹ The average price of the land used for housing purposes under the Government Scheme, 1919-1922, was approximately £180 per acre.

entirely on back land, but at the entrances sufficiently wide openings are left to afford a fairly complete view of it from each of the four roads. The cost of the road frontage in this case is £660, or approximately the same as in Fig. 77. A comparison between these results is best obtained by tabulating them in parallel columns.

TABLE V.—COMPARISON BETWEEN THE COST OF OPEN SPACES OCCUPYING DIFFERENT AMOUNTS OF ROAD FRONTAGE AS SHOWN IN FIGS. 76, 77, AND 78.

Arrangement.	Area of Open Space.	Cost of Land at £200 per Acre.	Cost of Road Frontage at £1 per ft. ln.	Total Cost of Land and Roads.	Number of Houses over-looking Open Space.
Fig. 76 . .	5·646 acres	£1130	£2260	£3390	80
Fig. 77 . .	5·646 „	1130	600	1730	92
Fig. 78 . .	5·646 „	1130	660	1790	112

It will be observed that in Fig. 76 the total cost of the open space is almost double that in 77 and 78, although the area is the same in each case; or, regarded in another way, the difference in cost is equivalent to the value of approximately 8 acres of additional land. Moreover, in spite of the fact that it occupies back land almost exclusively in 78 and very largely in 77, the number of houses which command a view over the park is considerably greater in the former, and slightly greater in the latter, arrangement than where it is completely surrounded by roads. When, therefore, there is only a limited sum of money available for the provision of open spaces, it is important to consider carefully whether the circumstances make it more worth while to secure a larger area with less frontage, or a smaller area with greater frontage. The general aim should be to obtain the maximum of decorative effect with the minimum of expenditure upon road charges.

While, however, the strictest economy in this direction is essential in the development of working-class areas, the same stringency is not so necessary in the laying out of estates for rather larger houses. In such schemes it will usually be found that the enhanced value of the building sites overlooking the open space will more than recoup the outlay on the road surrounding it.

GARDENS AND ALLOTMENTS

One of the principal objects of adopting a lower density per acre in housing development is to ensure that every tenant shall have a plot of sufficient size to be worth cultivating. The value of the garden or allotment as a means of supplementing the family food supply was so evident during the War that enthusiasm for gardening was greatly stimulated, and this factor, together with the greater amount of leisure time enjoyed by reason both of the shorter working day and of the Daylight Saving Act, is likely to result in a permanently greater demand for a garden of adequate dimensions. The advantages, the convenience and amenity, of having the garden directly attached to the house are too obvious to require explanation, but as it is probable that the desire for a full-sized plot will not be universal, it is necessary to consider the best way in which to allocate the available space.

Allocation of Land as between Private Gardens and Allotment Areas.—It has been demonstrated that an average plot of one-twelfth of an acre per house will provide, under intensive cultivation, just sufficient land to produce the vegetables consumed by a normal family. Where, therefore, the housing scheme forms only a small fraction of the total housing accommodation of the locality, and consequently applications for tenancy will come chiefly from those who desire to have and to cultivate a garden, the whole of the available land may safely be allotted

to the individual houses. Experience shows that in such circumstances the land will be utilised to advantage. But in larger schemes it will generally be wiser not to assume that all the tenants will want gardens of equal size, and in this case it will be better to reduce the size of the plot attached to the houses and arrange for part of the land to be let in separate allotments to those tenants who desire it. The precise allocation of space as between gardens and allotments will naturally depend upon the circumstances in each case, but the following example will illustrate the principle upon which the calculation would be made. Let us say that in a scheme comprising 960 houses it is estimated that only one-third of the tenants will require an allotment in addition to a small garden. The total area available will amount, at a net density of 12 houses to the acre, to 80 acres, and out of this aggregate it is necessary to provide for 320 allotments of 10 rods each. This entails the reservation of 20 acres, or one-quarter of the total area. Hence the gardens attached to the houses must be reduced by a quarter, and the average size of the plots will be therefore, in round figures, 300 square yards instead of 400 square yards.

The Placing of Allotments.—In some cases it is convenient to make use of land which is low lying, not easily drained, or otherwise unsuitable for building development, for the purpose of allotments. But, apart from special circumstances of this kind, it is generally much better to place them at the back of the houses. This position, besides being more convenient for the tenant, is undoubtedly more satisfactory from the point of view of economical development, for the normal size and shape of land block can then be retained and the area resulting from the reduction in the size of the individual gardens will form a compact enclosure in the interior of the block—readily accessible and easily divisible to suit the requirements of the surrounding inhabitants. The London County Council

have adopted this system in many of their schemes, and it is well illustrated in the plan reproduced in Fig. 79.

Arrangement and Appearance.—Much of the untidiness usually associated with allotment gardens is due to the collection of sheds and small glass-houses, contrived out of miscellaneous materials and casually disposed about the site. It is not difficult, therefore, to effect a considerable improvement in their appearance by the simple means of arranging the plots and the paths giving access to them in an orderly manner and grouping, at convenient places, tool sheds of an unpretentious character and uniform design. There is no evident reason why allotments should not be as agreeable to look upon as the charming rural cottage gardens which are their prototypes; and when amongst townsfolk the same gardening traditions have grown up as exist with country people, this result will probably be achieved. In the meantime, there is a good deal to be said in favour of keeping them discreetly screened from the public gaze.

Private Gardens.—The arrangement of the private gardens attached to the houses is necessarily a matter which must be left to the individual owners or tenants. But in order that they should be able to make the best use of the ground available, it should be the aim of the site planner to provide, as far as possible, plots which are rectangular in shape and set square with the house. Gardens of attenuated form, particularly those tapering to a point, are always difficult and unsatisfactory to deal with and should be avoided, though the exigencies of planning sometimes make the latter almost inevitable. In such cases the formation of a small orchard or group of trees in the position which would otherwise be occupied by the apices of the separate plots, will obviate to some extent the cramping effect of sharply convergent hedge or fence lines. The equitable division of land between houses grouped round three sides of a quadrangle is always somewhat of a

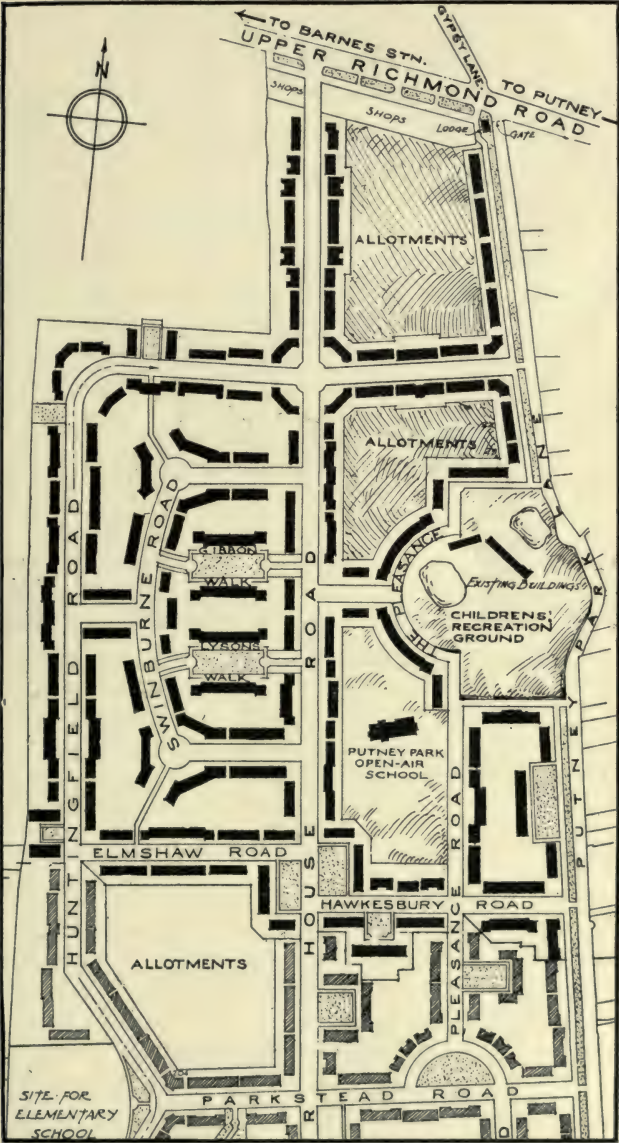


FIG. 79.—Lay-out plan of L.C.C. Housing Scheme at Rochampton. G. Topham Forrest, Chief Architect.

problem, but the desperate solution illustrated at A in Fig. 80—and not, unfortunately, so uncommon as could be wished—should never be employed. Any advantage there may be in the more equal distribution of ground secured by this arrangement is more than neutralised by the awkward shapes of the plots and the fact that, owing to their being set obliquely in relation to the houses, they are directly overlooked from the next-door windows and all privacy is therefore destroyed. It is far better to recognise that,

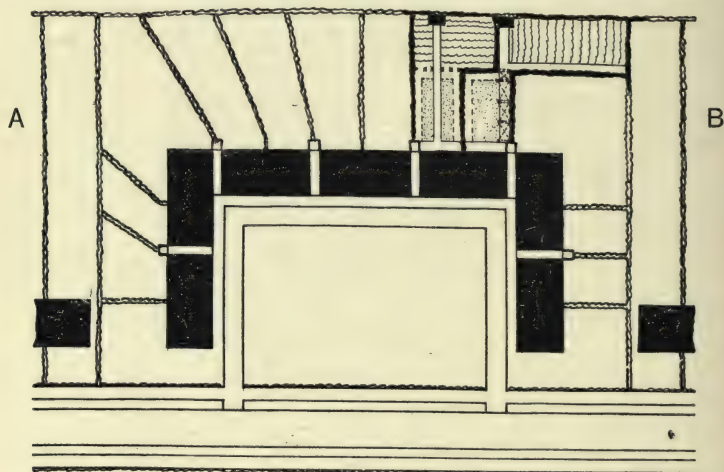


FIG. 80.—Illustrating at A a not uncommon but objectionable subdivision of gardens, and at B a more satisfactory method.

under such circumstances, plots of equal area are not practicable, and consequently to adopt an arrangement on the lines of that shown at B in Fig. 80.

Treatment of Forecourts.—The amenity of a residential district depends in great measure upon the way in which the gardens are cultivated. This is true both of back and front gardens, but inasmuch as the latter are under more general observation than the former, their appearance is of greater public importance. As in the arrangement and architecture of the houses, the harmonious effect of the

street as a whole should be the primary consideration, and the treatment of individual gardens should be subordinated thereto. The most successful way of achieving this result is to be found in the complete elimination of the fences or hedges dividing the separate forecourts from each other and from the road. This practice is followed in some American and Canadian cities, but it is doubtful whether, in a country of such marked individualism as England, it would meet with general approval. There is, however, nothing to prevent a simpler and more uniform treatment of the front fences and hedges, and if this is carried out with occasional groups of trees or flowering shrubs to emphasise the grouping of the houses, some continuity of design will be apparent and the impression produced by the street will at least be harmonious in its main features.

CHAPTER IX

THE DISPOSITION OF THE BUILDINGS

Necessity for Co-operation between Architect and Site Planner.—When the lay-out of the roads has been decided upon in all but final detail, it becomes necessary to consider

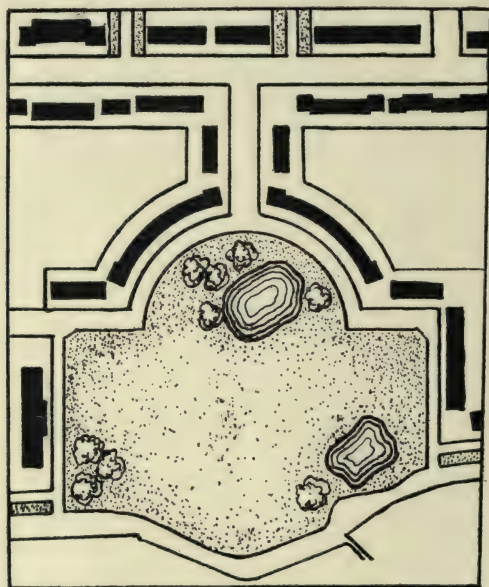


FIG. 81.—Grouping of houses influenced by Pond in L.C.C. Housing Scheme at Roehampton. G. Topham Forrest, Chief Architect.

the disposition of the buildings upon the frontage created. It is well that this should be done before the precise alignment of the roads is irrevocably fixed, because in arranging the houses it nearly always happens that the frontage



FIG. 82.—Houses grouped round pond in L.C.C. Housing Scheme at Roehampton. For plan, see Fig. 81.
G. Topham Forrest, Chief Architect.

available is either just too short or just too long for the desired grouping, a fault easily corrected at this stage by a slight adjustment of the roads, which might prove expensive or even impossible when the work was in hand. Too much care cannot be spent upon this, the final stage of the development plan, as, however well the roads may have been planned, the actual appearance of the scheme is made or marred by the buildings. Co-operation between the Architect and the Site Planner is therefore essential, for the houses should be designed not as isolated units, or even isolated blocks, but as part of a definite composition having a social as well as an architectural significance. It is not enough that such and such a street should have nice houses in it ; what is wanted is that the whole street rather than the individual houses should become the unit of criticism, not only from the point of view of casual visitors, but essentially from that of the residents. For although the saying that "an Englishman's home is his castle" expresses a fundamental truth, it ought not to be applied (as it is all too frequently applied) in the sense that every man is at liberty to build himself whatever sort of house he likes, regardless of the feelings of his neighbours. So far as the interior of the house is concerned, there is no reason why his wildest whim should not be indulged, because the result will only be seen by the privileged few. But the external appearance is an altogether different matter, for it is visible to all and sundry, who as neighbours or passers-by are compelled to take it, upon the terms of the marriage contract, for better or worse. Every house reflects to some extent the character of its owner. His tendencies in the direction of refinement or vulgarity will be discernible in the restraint or ostentation displayed by the house in which he lives ; but more especially will his social and civic instincts be proclaimed. For in towns—which owe their very existence to the recognition of the advantages of human association in every sphere of human activity—

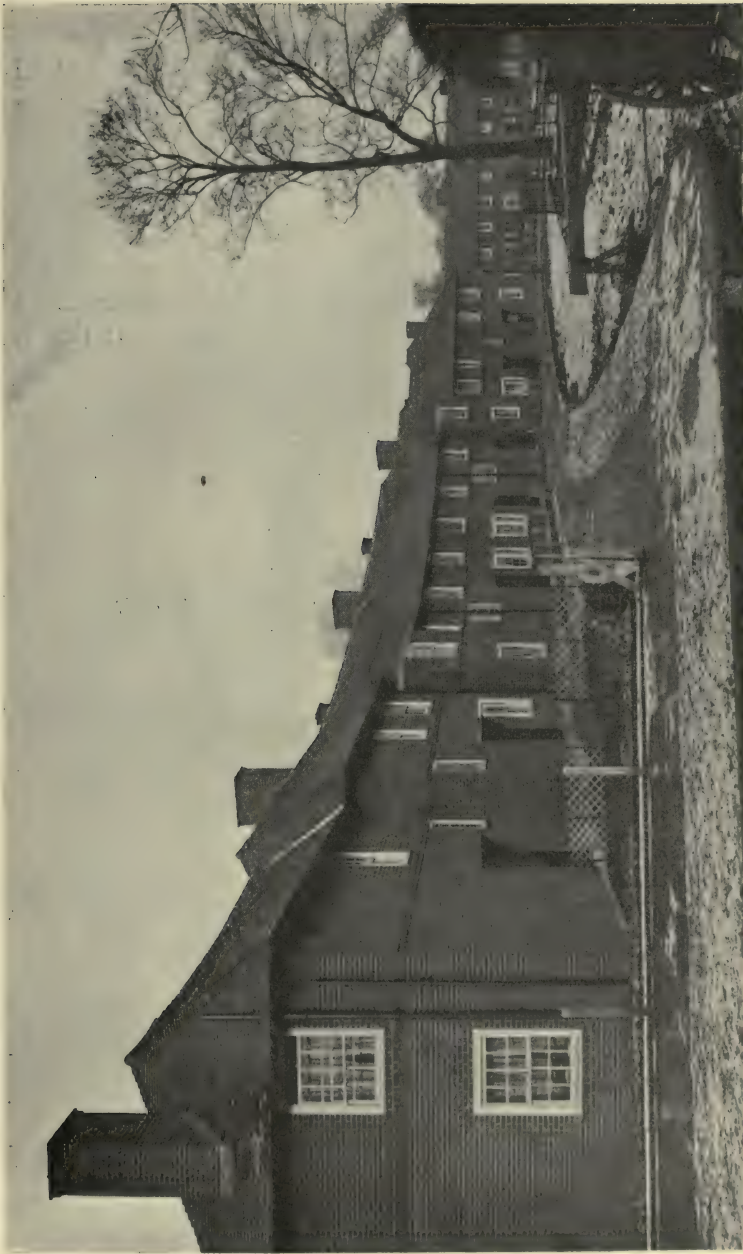


FIG. 83.—House grouping in the L. C. C. Housing Scheme at Rochampton. For plan, see Fig. 81. G. Topham Forrest, Chief Architect.

any one who has the social faculty and the civic sense at all developed, will recognise that the city is an organic whole and the citizens a community. It follows from this that the city should express the corporate rather than the individual aspirations of its citizens, and, returning once more to our street, that the design and grouping of the houses should aim at emphasising their social relationship as neighbours rather than their unsocial relationship as exclusive strangers. It must not be assumed that this is

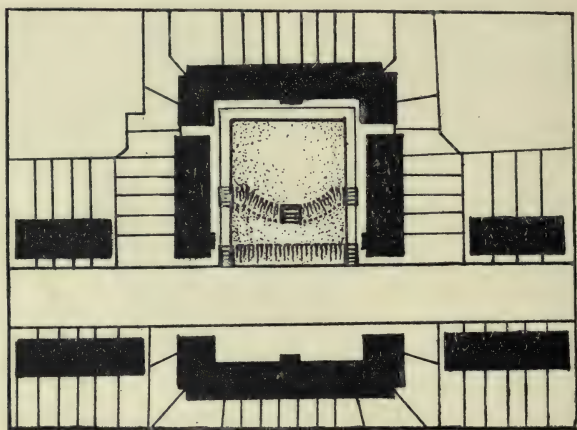


FIG. 84.—Plan of group at Norbury illustrated in Fig. 85.

an argument in favour of the monotonous repetition of one design with which we are all, unfortunately, so familiar. Such an arrangement is not an expression of neighbourliness ; it is rather an expression of selfish ineptitude on the part of the builder. But in the attempt to avoid this very fault, there is often a tendency towards the introduction of a great variety of types, alike in their general size and shape, but differing in minor details. The result is the exact opposite of that intended, for the continual competition between houses of equal bulk but slightly different elevation is very wearisome ; it resembles a crowd of



FIG. 85.—Grouping of houses on sloping ground in L.C.C. Housing Scheme at Norbury. G. Topham Forrest, Chief Architect.

mediocre people unwillingly assembled and endeavouring, under trying circumstances, to assert their individuality. Much more successful is the designer who contrives to give character and distinction to each street by treating it as far as possible as a single composition in which the

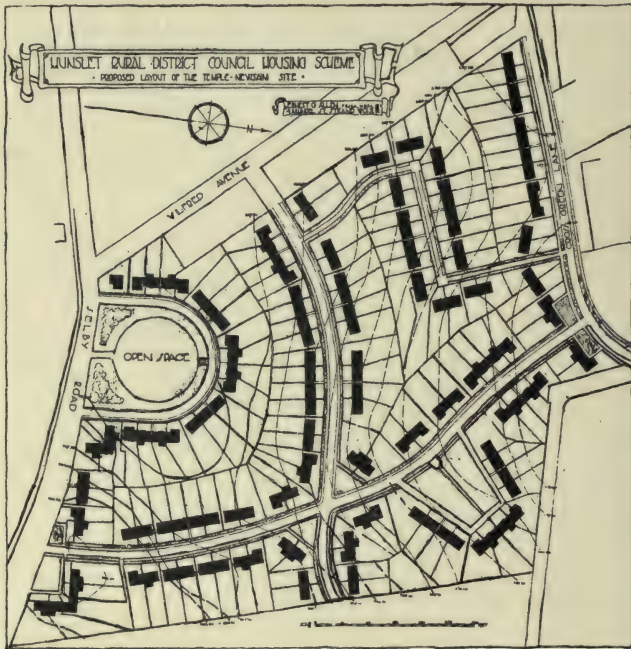


FIG. 86.—Lay-out of Temple-Newsam Housing Scheme. Note houses grouped round site of old reservoir, now converted into a sunk garden. Ernest G. Allen & Partners, Architects.

individual houses are subordinated to the harmony of the whole, and emphasis is obtained by special grouping at some appropriate position.

Use of Natural Features to secure distinctive Arrangement of Buildings.—Almost every site possesses some natural feature, such as a group of trees, a pond, a knoll or valley, or perhaps a particularly fine prospect, which seems



FIG. 87.—Village Green and pond, Penn, Bucks.

to demand a special arrangement of the buildings. Such opportunities should be seized at once, since the grouping at these points is very important, both as regards the general impression produced by the scheme, and also as the key to the disposition of the buildings in their immediate vicinity. Examples of grouping influenced by such features are illustrated in Figs. 81-86. At Roehampton the tree-bordered pool, and at Norbury the short, steep rise in the ground, have each inspired an arrangement of the houses pleasing in itself and imparting a distinctive character to its surroundings.

The Grouping of Public Buildings.—Other opportunities are afforded in connection with the placing of Public Buildings. In discussing the general principles upon which sites should be reserved for this purpose, something was said about the arrangement of the buildings, particularly in connection with the central *place* of the Scheme. The suggestion was then made that the combination of public buildings, inns, shops, and private houses, which is such a characteristic feature of the market-squares and greens of many of our old country towns and villages, might very suitably be adapted to the requirements of a housing scheme. There would seem to be something particularly appropriate in such an arrangement; for the domesticity, which is part of the charm of the old market-places, is exactly the quality that is necessary to the success of the centre of a residential district in a modern town.

Civic Centres.—*Village Greens.*—The Civic Centres of the past, although of many and widely differing forms, fall naturally into two main categories: those which rely for their effect upon the sense of enclosure produced by relatively small areas being surrounded by a frame of buildings as continuous as circumstances allow, and those in which the predominant feature is an open green. But even in the latter form, if the feeling of a centre is to be retained, there must be some sense of enclosure. Owing



FIG. 88. — Village Green and pond, Goudhurst, Kent.



FIG. 89.—The Church Square, Winchelsea.

to the greater extent of the space enclosed, the continuity of the buildings is not so essential as in the case of the smaller *places*, because the interest is chiefly concentrated upon the green rather than upon the buildings, and, these being farther away, gaps between the houses are not so noticeable. Nevertheless the houses should be reasonably close together, and sufficiently continuous to make the definition between the green and its surroundings quite clear. This is a very important factor in the successful

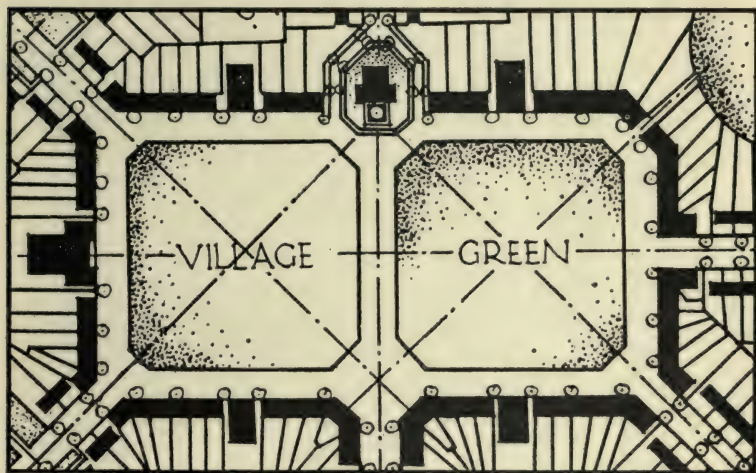


FIG. 90.—Village Green in Housing Scheme at Newark. See also Fig. 10.

design of this type of centre, as anything in the nature of uncertainty as to its limits goes far to destroy the impression of completeness which should be one of its chief attributes. A great deal, of course, depends on the levels of the ground. An absolutely flat site affords an opportunity for such charming results as are illustrated in Figs. 87-91. On the other hand, a green in the shallow basin of a valley is equally delightful (see Fig. 62), while sloping ground is also susceptible of effective treatment. But a position on the summit of a hill with the ground falling away

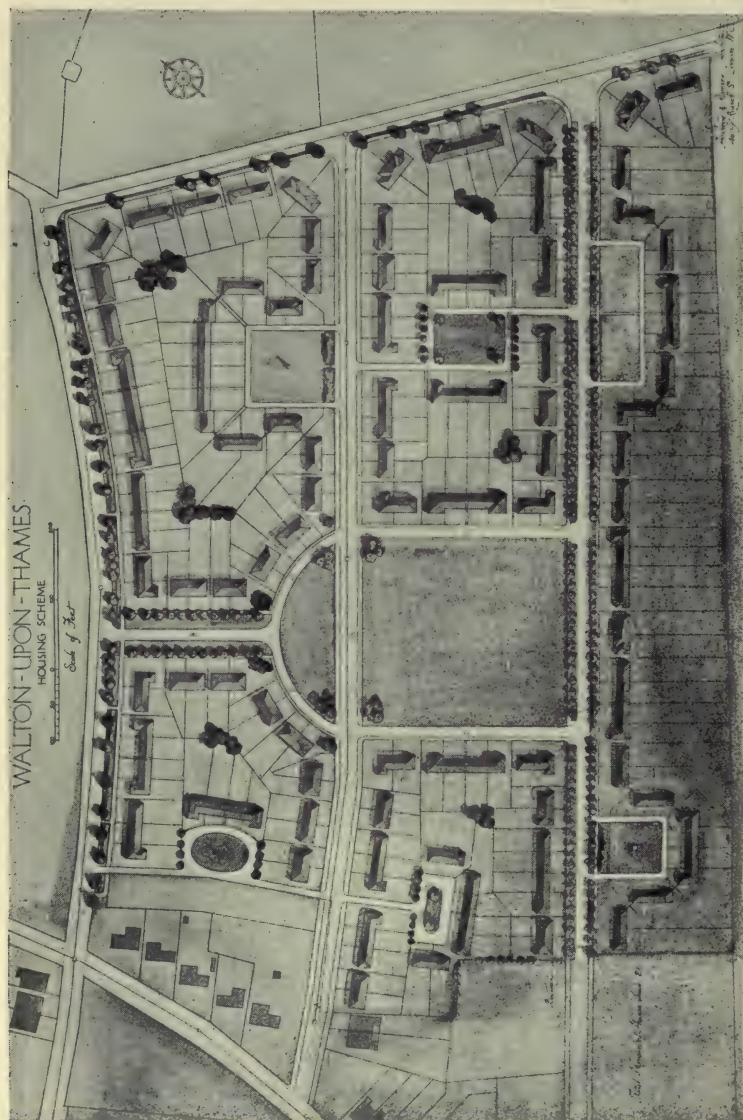


FIG. 91.—Village Green in Housing Scheme at Walton-upon-Thames. Adshead & Ramsey, Architects

in all directions, although frequently chosen in modern developments, is never really satisfactory, as, except from the middle of the green, it is impossible to obtain a complete picture of the centre, and all sense of enclosure is lost.

Enclosed Places.—In the built-up *place* the sense of enclosure is even more necessary than in the case of the village-green type of centre. Continuity in the surrounding buildings is therefore the object to be sought, and the breaks caused by roads entering the *place* should be reduced to a minimum or effectively masked. For this reason the meeting-point of several roads, although suitable in other respects, does not form an ideal position for the civic centre of a scheme. It is one, however, that is frequently chosen, and various ways in which it may be handled are shown in Figs. 15, 19, 21, 35, 57, and 92. It will be noticed that the entering roads sadly break up the continuity of the

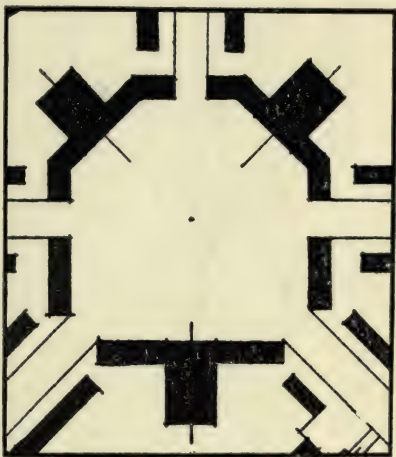


FIG. 92.—Civic centre in Housing Scheme at Llay. See also Fig. 21.

buildings, though in the Barry, Llay, and Swanpool Schemes this disadvantage is mitigated to some extent by closing the vistas. A more satisfactory result can usually be obtained by placing the centre in such a position that while sufficient connection is maintained with the main traffic routes, the latter are not too obtrusive. A very delightful example of a square designed upon this principle is to be found at Tremadoc and is illustrated in Figs. 93–95. Here the square is set at right angles to the main road which crosses one end of it. A somewhat similar arrangement has been

adopted for the shopping centre in the Liverpool Walton-Clubmoor Scheme (see Fig. 96), and an interesting variation of it occurs in the Newburn, Throckley Scheme (Fig.

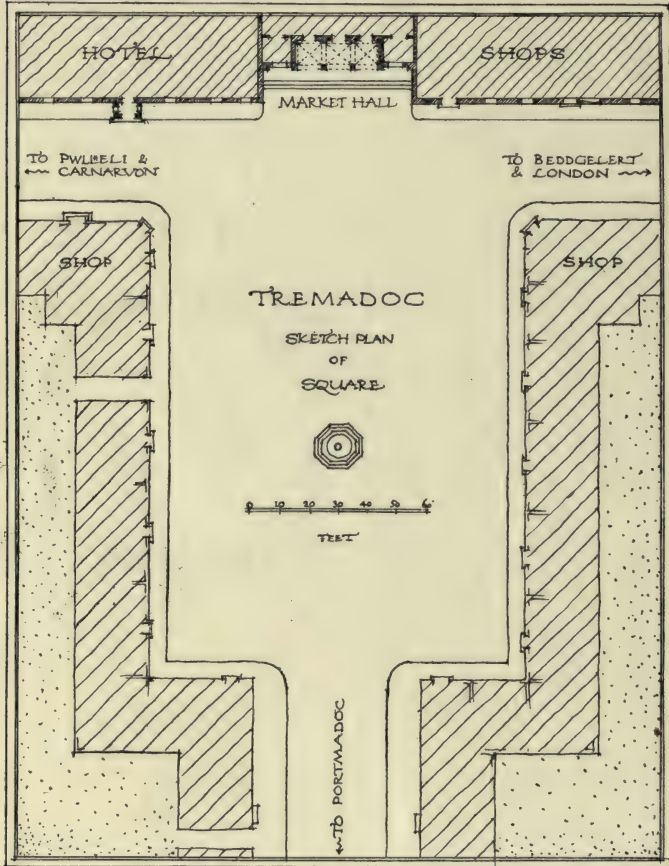


FIG. 93.—Plan of the Square, Tremadoc.

(Illustration by courtesy of the *Town Planning Review*.)

97). In small country towns and villages the central feature very frequently takes the form of a widening of the High Street, and many delightful instances, such as those in Figs. 99 and 100, are to be found all over the country.

Definite market-squares, on the other hand, are not so commonly encountered, and they are, therefore, doubly attractive (see Figs. 16-18). But either of these devices has a wealth of suggestion to offer in connection with the design of the Centre for a Housing Scheme.



FIG. 94.—The Square, Tremadoc, viewed from the hilltop.
(Illustration by courtesy of the *Town Planning Review*.)

Buildings requiring Separate Locations.—The placing of the public buildings, such as churches and schools, which in modern development are not suitably accommodated in the central *place*, requires careful consideration. In an earlier chapter there was a discussion as to what kind

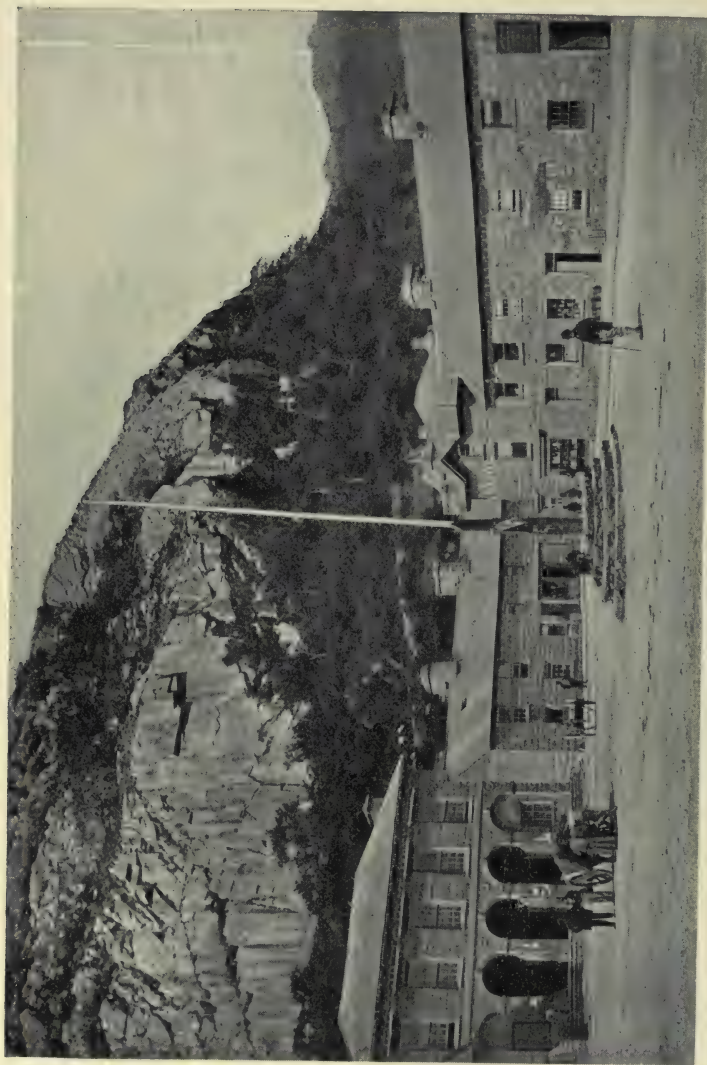


FIG. 95.—The Square, Tremadoc.
(Illustration by courtesy of the *Town Planning Review*.)

of site was suitable for these buildings, but it was then pointed out that the final choice cannot be made until the road plan has been prepared. At this stage, however, it is possible to go into the matter in greater detail.

Places of Worship.—Churches and other places of worship require a certain degree of prominence, and they should be readily accessible from all parts of the neighbour-

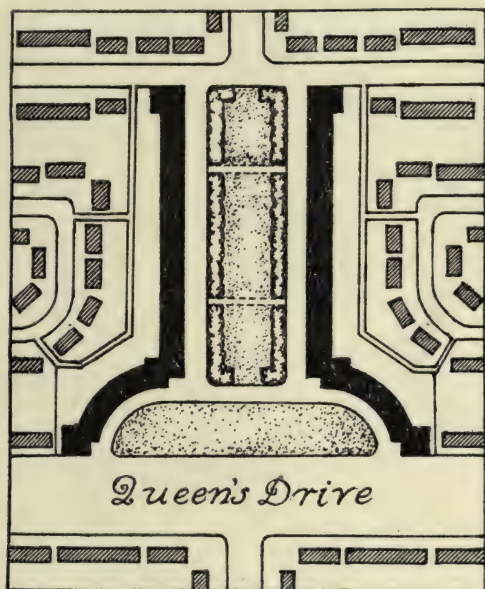


FIG. 96.—Shopping centre in the Walton-Clubmoor Housing Scheme at Liverpool.

hood in which they are situated. Hence a position at the top of rising ground, or at the end of a street, where a building of distinctive character is needed to close the vista, will usually be satisfactory. Examples of this will be found in the Dartford, Dover, and Newark Schemes (Figs. 56, 63, and 10), of which the two last named are particularly interesting, as they show, on the one hand, the use of long vistas from several different angles, possible only on a flat site, and, on

the other, the short, steep view that is characteristic of a well-placed building in a hilly district. In the Liverpool Schemes (see Figs. 12-14) sites have been chosen which, though not precisely axial with any of the roads, will figure in the vistas of several, while at Brighton (Fig. 62) and Abercarn (Fig. 66) the churches have been placed very skilfully in relation to the centre.

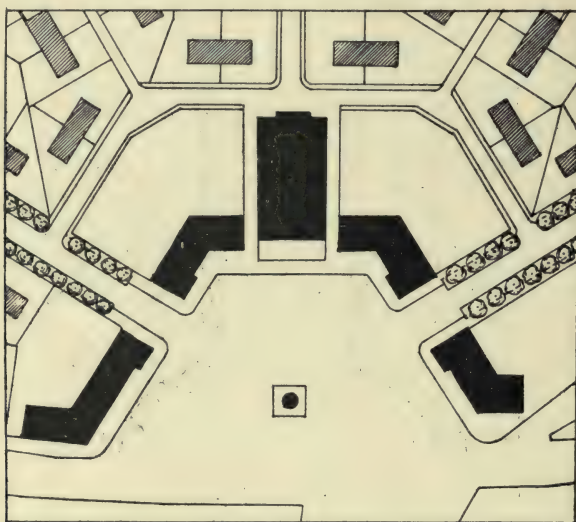


FIG. 97.—Civic centre in Housing Scheme at Throckley, Newburn-on-Tyne.

Schools.—Schools, on the other hand, although they should be equally accessible, do not require the emphasis that is appropriate, for instance, to a church. The disabilities under which schools have suffered have not been chiefly due to the lack of a sufficiently distinguished site, but rather to the utter inadequacy of the area available for playgrounds. The satisfaction of this requirement is, therefore, of prime importance, and in order to secure sufficient space without wasting large sums of money upon road frontage, the practice has been almost universally adopted of placing schools in positions where the bulk of

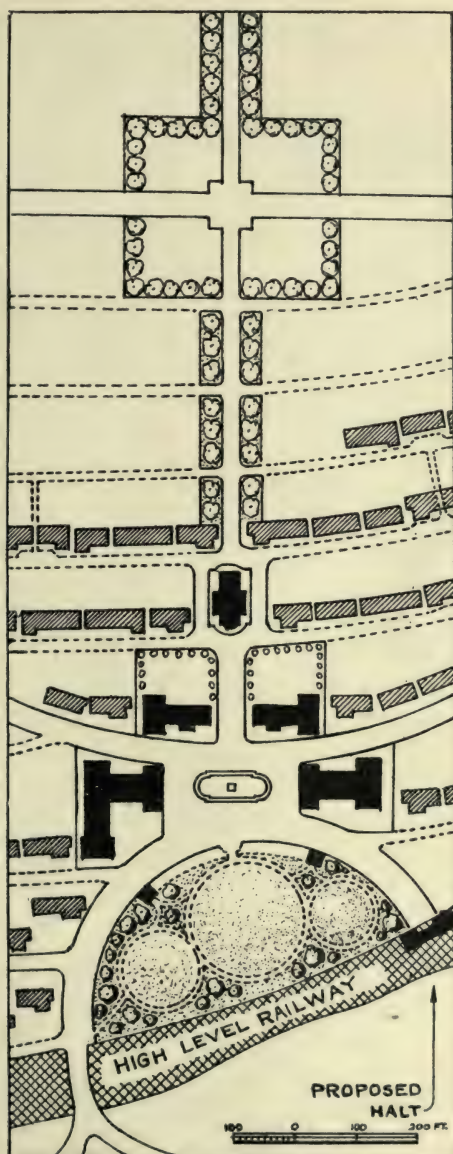


FIG. 98.—Civic centre in the Housing Scheme at Treowen, Abercarn.



FIG. 99.—High Street, Tenterden.

the site is back land, with only such frontage as is required for the building and convenient access to it. Typical

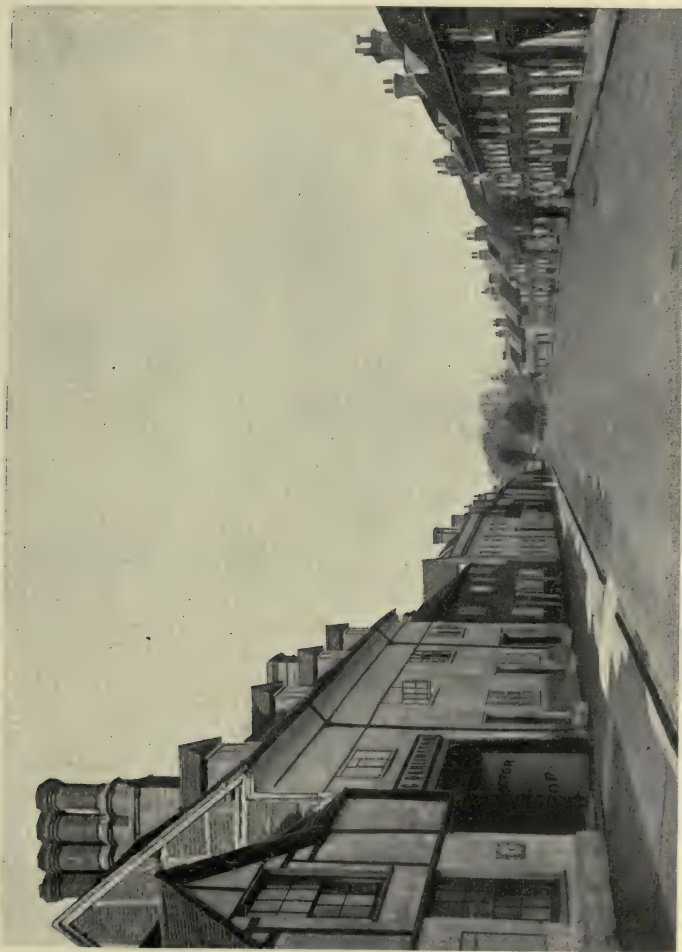


FIG. 100.—High Street, Amersham.

examples will be seen in the plans of the Bellingham (Fig. 57), Walton-Clubmoor (Fig. 14), and Larkhill (Fig. 12) Schemes, while at Newark (Fig. 10) the principle has been extended to the extreme case of providing no

frontage at all! The arrangement recommended in Chapter IV. of locating schools in connection with Public Playing Fields has been followed at Springwood-Allerton (Fig. 13), Dover (Fig. 63), and Lemington-on-Tyne (Fig. 73).

In the case of both schools and places of worship, and wherever an individual building occupies a somewhat prominent position, it is very necessary that a proper relationship should be established between the building and its surroundings. This may be done in a great variety of ways by grouping the adjacent houses and planting trees in order to form a suitable background or setting.

Arrangement of the Houses.—*Building Lines.*—When the principal groups have been settled, attention must be directed towards the arrangement of the houses upon the roads. In this matter the general question of building lines has to be decided at the outset. The distance between buildings, either as prescribed in local by-laws or as fixed (at 70 feet) by the regulations issued in connection with the Government Housing Scheme, have been determined on too arbitrary a basis to be universally satisfactory. Mr. Edwards' researches show conclusively that, from the point of view of securing a reasonable amount of sunshine in the streets, some system of graduated widths is a more rational solution of the problem, and it is suggested, therefore, that minimum building lines should be regulated upon the basis of the height of the buildings and the orientation of the street. This in itself would provide an important means of differentiating between minor streets—the individuality of which depends, perhaps, as much upon their width in relation to neighbouring streets, as upon the architectural character or grouping of the houses. The best results cannot, therefore, be obtained if uniformity is enforced in this particular, for, as the houses are all of approximately the same height, the proportions of the frame formed by the street and the buildings on either side of it will be almost identical in every case, and despite

attempts to avoid monotony by different grouping of the houses, the general effect will tend to similarity rather than to individuality.

Considered Grouping.—The character imparted to streets by judicious grouping of the houses is, nevertheless, an essential feature of the *tout ensemble*, and it is worth while devoting considerable care to this part of the subject. It is important that there should be some adequate and

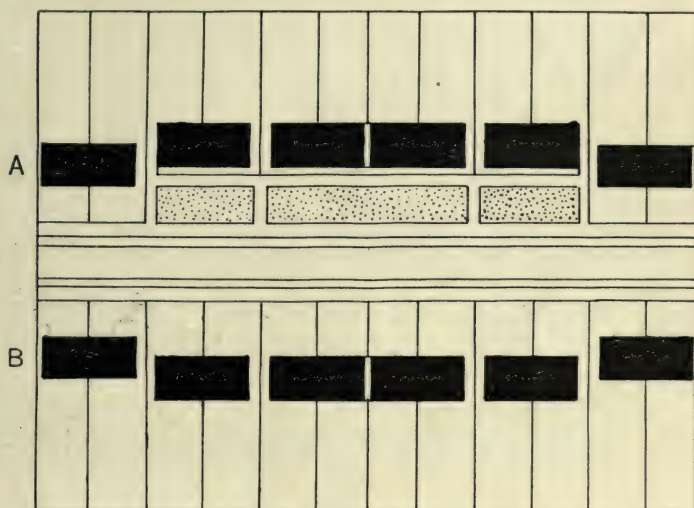


FIG. 101.—The treatment of the forecourts should reflect the house grouping : compare A where it does, with B where it does not.

apparent reason for departing from the straightforward arrangement of houses along a common building line. Nothing looks worse than the meaningless setting backwards and forwards of houses which is sometimes resorted to in the endeavour to avoid monotony. Even where a break in the line of houses shows definite elements of design, there should be some corresponding feature in the road to suggest a reason for the arrangement adopted ; the comparison between diagrams (a) and (b) in Fig. 101 will make

this clear. The desire to make a road "interesting" frequently leads even the most well-intentioned to overdo grouping altogether. This tendency is noticeable both in the composition of the separate house blocks and also in their general arrangement. Apart from the additional expense incurred by the extra brickwork and complicated roof construction—unavoidable in a much broken-up plan—the result is generally too restless to be really



FIG. 102.—Turning place in road reflected by arrangement of houses.
Burry Port Garden Suburb. T. Alwyn Lloyd, Architect.

effective. In the same way, too great a number of special groups tends to reduce the individual value of each, and to destroy the harmony of the street. Thus, even in comparatively long roads it is wise to concentrate on a very few well-considered groups.

Treatment at Road Junctions.—Suitable positions readily suggest themselves. A road junction or turning place, for example, forms a natural break in the continuity of the houses, and, where such breaks do not occur too frequently, it is fitting to give them a suitable emphasis. This may



FIG. 103.—A completely built-up corner.



FIG. 104.—Arrangement giving the feeling of a built-up corner.

be done in a variety of ways of which some examples are given in Figs. 102-9. The completely built-up square corner, illustrated in Fig. 103, is very charming, but is rendered difficult of execution so long as by-laws require a specified area of open space attached to the back of the building. Something of the feeling of a built-up corner can be secured, however, by an arrangement such as that



FIG. 105.—Typical arrangement at a right-angled junction.

shown in Fig. 104. Typical ways of treating a simple right-angled junction are seen in Figs. 105 and 106, but here the awkward shapes of the back gardens detract somewhat from the utility of a plan which, considered from the æsthetic point of view, is quite satisfactory. The method followed in Fig. 107 is free from this defect, but it requires very careful handling in order to avoid the only too familiar by-law corner; something in the nature of a wall or high hedge to connect up and relate the buildings in an arrange-

ment of this kind is absolutely essential. The importance of the road junction or crossing will regulate the scale of the planning and the weight of the emphasis, but in every case the plotting of the houses should reflect in some measure the plan of the roads. Thus a symmetrical crossing calls for a symmetrical arrangement of the buildings, and the junction with a side road should receive recognition in the



FIG. 106.—Treatment of right-angled junction. Compare with Fig. 105, and note improvement effected by introduction of tool-house and trellis.

grouping on both sides of the principal road (see Fig. 108). Such an arrangement is an indication that the side road has been planned to enter at a definite place, properly prepared to receive it, and avoids giving the impression that the junction is a casual affair which might equally well have occurred at any other point. It also has the merit of preserving a feeling of breadth at the entrance to the street, and ensures a terminal placed in the right position (see Fig. 110).



FIG 107.—Road-bay in L.C.C. Housing Scheme at Old Oak Common. Note arrangement of wing houses in relation to those on main road. G. Topham Forrest, Chief Architect.

Terminal Features to Street Vistas.—It is very desirable that the vista along the roads should be adequately closed. The terminal feature may take the form of some natural

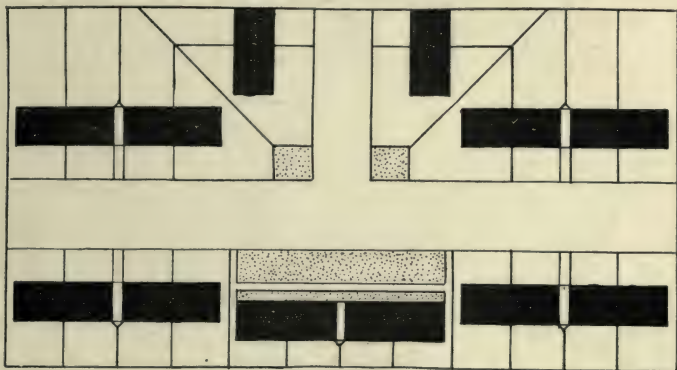


FIG. 108.—In this diagram the arrangement of houses on the lower side of the road suggests that the side road was planned to enter it at this particular place. Compare with Fig. 109.

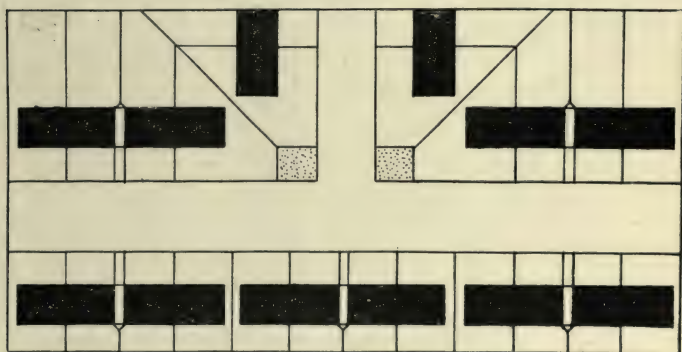


FIG. 109.—There is nothing in the arrangement of the houses on the lower side of the road in this diagram to indicate that the entry of the side road in this position is not a mere accident. Compare with Fig. 108.

object, such as a distant hill or a group of trees, or it may be a bridge or a building according to the circumstances; but, whatever it is, there should be something to arrest the eye and mark the definite conclusion of each particular



FIG. 110.—A feeling of breadth at the entrance to the street and a terminal placed in the right position.

view. For the more important roads the most suitable terminal will usually be a public building, which should be so placed that its façade is square with the principal vista. In many cases, and particularly at road junctions and points at which the street changes direction, this will result in the formation of a small *place* where the buildings can be grouped satisfactorily to close several vistas. This is a favourite device of mediæval town-planners, and Mr. Raymond Unwin, in his book, *Town Planning in Practice*, examines in some detail the advantages of such an arrangement from the point of view both of closing vistas and of giving the necessary sense of enclosure to the *place*. The same treatment is readily adaptable to similar conditions upon minor roads, and successful grouping of the houses in such positions is most effective.

Road-bays.—Where the depth of the land fronting a road is greater than is required and it is important to utilise the road frontage to the fullest extent, the arrangement of the houses round small greens recessed back from the road affords scope for distinctive grouping combined with economy in the cost of development. Figs. 111-115 illustrate several different methods of treating what may be termed "road-bays." It will be clear from the plans that such an arrangement accommodates an additional number of houses (varying with the depth of the bay) without incurring any further expense in road-making than that of the paths round the Greens. Road-bays are useful also in other directions. Situated in roads running east and west, they provide relief not only by breaking the building line, but also by affording sites with an east and west aspect, which gives the opportunity for using a different type of house than that required for the prevailing north and south aspects. Upon the north side of such a road they form admirable sun-traps, and they are particularly useful where it is desirable to give as many houses as possible a glimpse of an adjoining open space, or of an especially charming view.



FIG. 111.—A "road-bay" in the Moulescombe Housing Scheme at Brighton.



FIG. 112.—“Road-bay” in L.C.C. Housing Scheme at White Hart Lane. G. Topham Forrest, Chief Architect.



FIG. 113.—A “road-bay” in the L.C.C. Housing Scheme at Old Oak Common. G. Topham Forrest, Chief Architect.



FIG. 114.—Another “road-bay” in the L.C.C. Housing Scheme at White Hart Lane. G. Topham Forrest, Chief Architect.

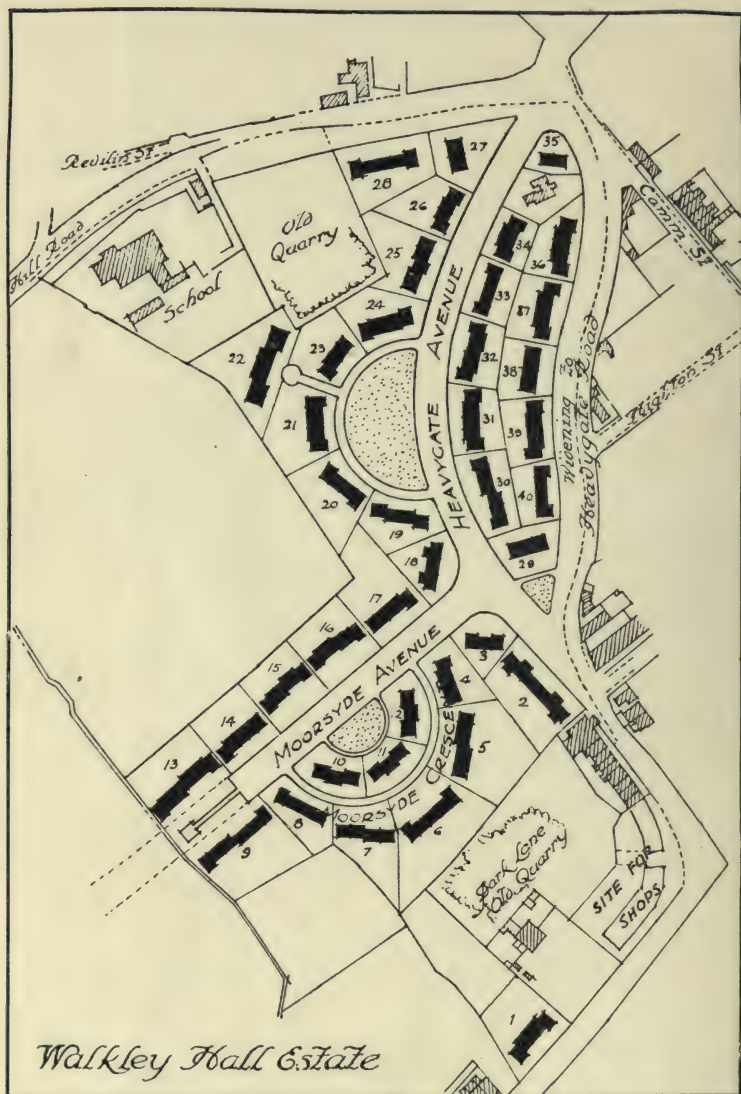


FIG. 115.—Illustrating the use of "road-bays" in the development of an awkwardly shaped site at Sheffield. F. E. P. Edwards, City Architect.

Used upon the frontage of an arterial road, they help considerably to mitigate the nuisance arising from the dust and noise created by the passage of fast traffic.

Culs-de-Sac.—Quite distinct in their typical forms, the road-bay and the cul-de-sac are so closely allied that there is no sharply defined line of demarcation between them. The only important difference between the grouping characterised as a road-bay in Fig. 107 and as a cul-de-sac in Fig. 120 is that access to the houses is provided by



FIG. 116.—Simple "set-back" of houses in Wyther House Scheme at Leeds.

means of a footpath in the former case, and by a light carriageway in the latter. And on the borderland between the two, the classification must depend upon the nature of the access to the houses. This seemingly trivial distinction is really of great importance, because it serves to mark the difference in function between the two forms of plan, namely, the more extensive development of back land which is the proper province of the cul-de-sac and requires the use of the carriageway, and the more restricted scope of the road-bay for which a footpath only is justified. Thus, from the point of view of road-making the cul-de-sac that



FIG. 117.—Simple "set-back" of houses in L.C.C. Housing Scheme at Rochampton. G. Topham Forrest, Chief Architect.

might equally well be a road-bay is extravagant, and, as one of the principal merits of the cul-de-sac is that it is essentially an economical method of development, it should be employed, as far as possible, only under conditions where it will be most effective in this respect. Reference was made in Chapter VI. to the remarkable economy in development charges attainable by the use of the cul-de-sac, and this characteristic has, without doubt, been responsible



FIG 118.—Houses set back from a dusty main road, with private footpath and intervening park strip. Burry Port Garden Suburb. T. Alwyn Lloyd, Architect. For plan, see Fig. 23.

for the resuscitation of an expedient which in its old form was universally condemned. Divested of all objectionable features, however, the modern cul-de-sac has many virtues besides that of economy, and some of the most satisfactory results regarded from both the residential and æsthetic standpoints have been achieved by its use. In common with other special forms of planning, it has its limitations; the too frequent repetition of one stereotyped design is, for example, decidedly monotonous. But monotony results from the manner in which it is used and is not inherent

in the idea of the cul-de-sac, as the variety of treatment exhibited in the Newark-on-Trent and Llay Schemes alone bears witness. Here are seen the ordinary short road with a turning space at the blind end ; T shaped culs-de-sac ; Greens, of various geometrical forms, ap-

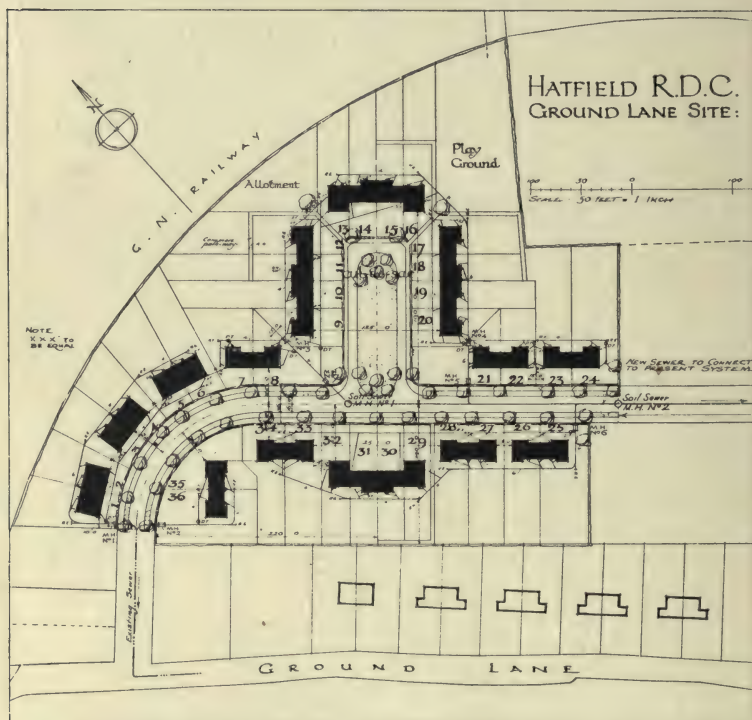


FIG. 119.—Cul-de-Sac in Housing Scheme at Hatfield.
Crickmer & Foxley, Architects.

proached by short roads and surrounded by houses ; curved, bent, and composite culs-de-sac of almost every variety of shape and size. The real limitations, in fact, are not imposed by questions of design, but by considerations of convenient access, means of escape in case of fire, and facility of police supervision. To meet the requirements



FIG. 120.—Cul-de-Sac in Housing Scheme at Hatfield. Crickmer & Toxley, Architects. For plan, see Fig. 119.

in these directions it is recommended that culs-de-sac should generally be straight and the greater part of them, at any rate, open to view from the entrance. In total length they should not exceed about 150 yards, and if in

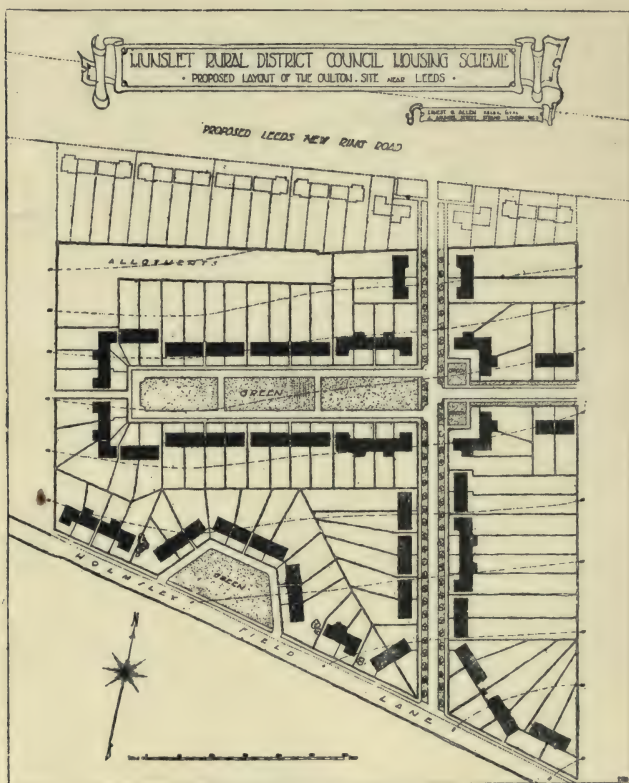


FIG. 121.—Cul-de-Sac in Housing Scheme at Oulton near Leeds.
Ernest G. Allen & Partners, Architects.

the shape of a T the combined length of the two arms should be within the same limit. If the length is greater than, say, 75 yards, a footpath 6 feet wide and adequately lighted should communicate, wherever reasonably possible, between the end of the cul-de-sac and an adjoining road.

The entrance to a cul-de-sac is an element of the design that requires careful consideration. The particular form it should take will depend primarily upon the degree of quiet and seclusion it is desired to achieve. The tranquillity of a college quadrangle or a Cathedral close—and such an atmosphere is eagerly sought by many people who, at any



FIG. 122.—Cul-de-Sac in Housing Scheme at Halfway, Eckington.
Percy B. Houfton, Architect.

rate in their homes, desire to escape from the restless hurry of present-day conditions—entails, for example, a very definite sense of enclosure which might well be secured by designing the entrance upon the lines of a College Gateway, or the less pretentious opening leading to an old Inn yard. This treatment has been used very successfully in the small Housing Scheme at Folkestone illustrated in Figs.

123-125. If, on the other hand, the objective is to provide a group of houses withdrawn to some extent from the main current of traffic, but still in close touch with it and com-

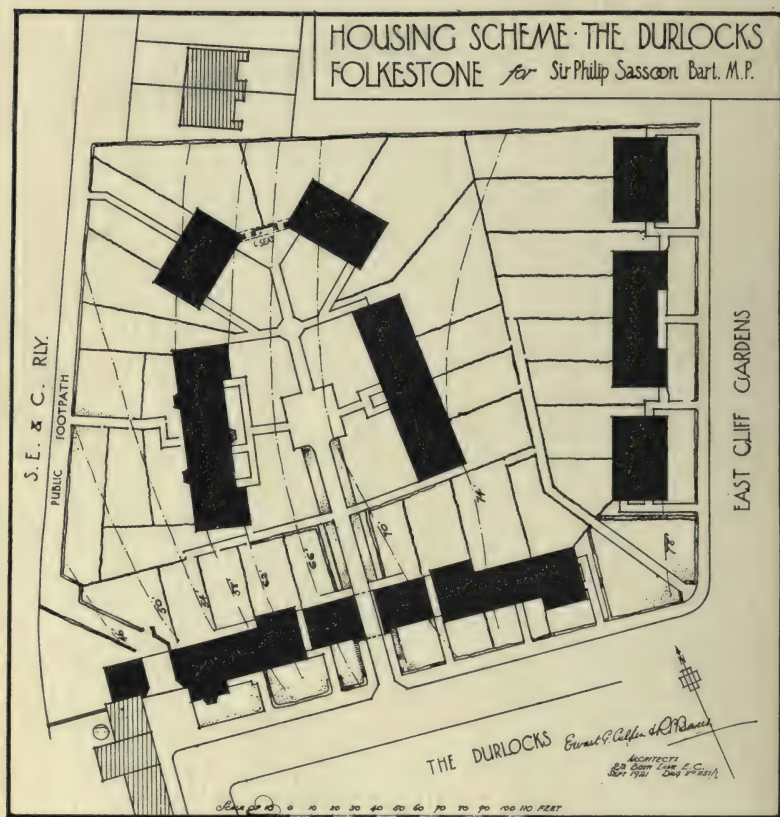


FIG. 123.—Cul-de-Sac in Housing Scheme at Folkestone.
Ewart G. Culpin & R. S. Bowers, Architects.

manding a good view of whatever passes to and fro in the street—and a large number of people prefer these conditions—it is, of course, necessary to keep the entrance as open as possible. The arrangement adopted in the Hatfield Scheme (Fig. 120) is an excellent example of this. The



FIG. 124.—Entrance to Cul-de-Sac in Housing Scheme at Folkestone.
Ewart G. Culpin & R. S. Bowers, Architects.



FIG. 125.—Way through houses in Housing Scheme at Folkestone.
Ewart G. Culpin & R. S. Bowers, Architects.

merely utilitarian cul-de-sac requires more ingenuity to treat successfully, as it partakes of the nature of a blind road rather than of a group of houses arranged in a certain way to achieve a definite effect. Suitable punctuation at the

end goes some way toward giving it character, but in this connection it is worth noting, that if the blocks of houses facing each other in this position are set too far back, the whole feeling of a cul-de-sac is destroyed, and the impression is created of another road crossing at right angles in front of the terminal building. The treatment of the entrance is also a somewhat difficult problem, because there is no particular feeling either of enclosure or openness to preserve, as in the two former types, and yet it is most



FIG. 126.—“Utilitarian” cul-de-sac in Burry Port Garden Suburb.
T. Alwyn Lloyd, Architect. For plan, see Fig. 23.

desirable that the entrance to a cul-de-sac should be easily distinguishable from that to a branch road. The best way of effecting this result is to render the opening less conspicuous by making it rather narrower and without too marked a break in the general building line; the reduced width and simple character of the cul-de-sac carriageway will also help to sustain the contrast.

Topography an important Factor in House Grouping.—Except upon a flat site the varying levels of the ground surface require careful study in connection with house

grouping, as otherwise the architectural effect it is desired to achieve may very largely be spoilt. This is particularly true in the case of formal arrangements, where, unless the symmetry of the group accords with the symmetry of the ground formation the most unfortunate result is obtained. Fig. 127 illustrates the way in which the balance of a cul-de-sac is partly destroyed if one side of it is appreciably higher than the other, especially where this circumstance is emphasised by a break in the roof line of the terminal



FIG. 127.—Example of cul-de-sac in which the levels of the ground destroy the effect of the symmetrical arrangement of the buildings.

buildings. A cul-de-sac running downhill is also unsatisfactory, because it gives the impression that the end houses are situated in a hole, and in order to avoid this feeling it is preferable to keep the view open at the lower end of a road having a downward gradient. On the other hand, a cul-de-sac running uphill is quite agreeable, as there is no suggestion of unhealthiness in the situation of any of the houses, and the closed vista under these conditions is very pleasing. In this case and in all others where buildings are intended to be seen at the end of an upward slope, it is important to choose such a position that the building is

completely visible to the pedestrian walking up the hill at all stages of his ascent. The appearance of a terminal feature, the lower half of which is obscured by the ground in front of it, is wholly marred, and the only way of avoiding this catastrophe is to set up the profile of the road and the lines of vision at different points, in order that the best position may be determined with some degree of certainty. This particular precaution serves to draw attention to the general desirability of regarding the lay-out, and more especially the arrangement of the houses, not merely as a plan, but also and principally as a design in three dimensions. Few men are so gifted that they can visualise the effect of a street picture from an inspection of the separate elevations and block plan alone, and one cannot but feel that many painful incongruities would have been avoided if the relatively small trouble had been taken to set up the elevations and perspectives of the whole of each street. The perspective view is particularly important, inasmuch as in comparatively narrow streets it is the chief impression received by the passer-by. It will be apparent, therefore, that special groups to be fully effective should be placed in positions where they can be viewed adequately from the front, while the main body of the houses in the street should be so disposed as to form a quiet and dignified picture, free from the fussiness of alternately repeated projections and recesses, hips and gables, which is intensified in the perspective view.

The Provision of Secondary Access.—Although an integral part of the house-grouping, the number of houses included under one roof is less a question of lay-out than of architectural composition, and upon the latter aspect of the subject it is not proposed to say more than to urge that the greater scope in street architecture afforded by the use of long blocks, or, better still, of continuous buildings should more frequently be turned to account. But in one respect the lay-out is directly affected, and that is in

connection with the provision of access to the backs of the houses for the purpose of the delivery of coal and the removal of refuse.

Semi-detached Houses with Side Entrances.—Where the houses are designed in pairs no difficulty arises, for in such cases access is readily obtained at the side. Where, however, the houses are grouped in blocks of three or more, it becomes necessary to devise some means of access to the backs of the middle houses which does not involve the highly disagreeable practice of carrying the coals and the dust-bin through the house itself.

Back Roads.—Several methods of dealing with this problem have been put forward from time to time. The earliest solution was the provision of a separate back road giving direct access to every backyard. Well adapted for its purely utilitarian purpose, it was open, nevertheless, to serious objection even when employed under the conditions for which it was originally designed. On the one hand, the cost of constructing, maintaining, lighting, and policing such roads was a considerable disadvantage, while, on the other, the depressing appearance of these narrow walled-in alleys was distinctly against them. But in modern development, at a density of 12 to the acre or thereabouts, this form of back access is still less desirable. It is true that the dreary walls could be replaced by hedges, and in this way much of the gloom could be dispelled; but the new factor which completely alters the conditions, is the increase in the size of the house-plot. Figs. 128 and 129 illustrate the three positions in which it is possible to put the back road in relation to the house. In the first of these a long garden intervenes between the back road and the houses, an arrangement involving a considerable increase in the labour of fetching coals and collecting refuse. If, on the other hand, the houses are set back in order to avoid this difficulty, the privacy of the gardens is immediately destroyed and the view from the back

windows is restricted to the backyards. The third plan, which is a compromise obtained by keeping the houses near the front road and placing the back road just at their rear, is not to be recommended, as the gain in convenience is largely neutralised by the loss in amenity due to the

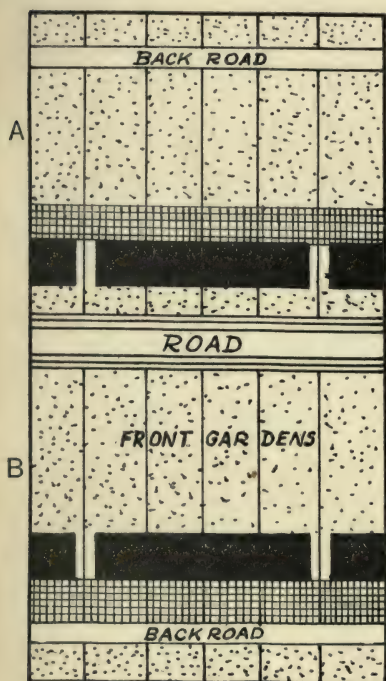


FIG. 128. — A, Back road at end of gardens.
B, Houses set back so that their yards abut on the back road.

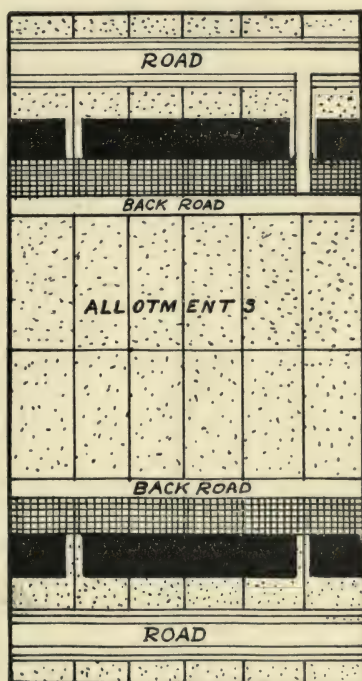


FIG. 129. — Duplication of back road.

separation of the garden from the house ; the fact also, that the back road in this system serves only a single instead of a double row of houses, means that its length is doubled ; and in view of the high cost in road making such an arrangement could not be justified.

Back Footpaths.—In order to overcome these defects

various modifications have been introduced of which typical examples are illustrated in Fig. 130. It will be observed that in Fig. 130 (A) a footpath replaces the back road of the plan shown in Fig. 129. Access to this footpath is provided by short carriageways between the blocks up

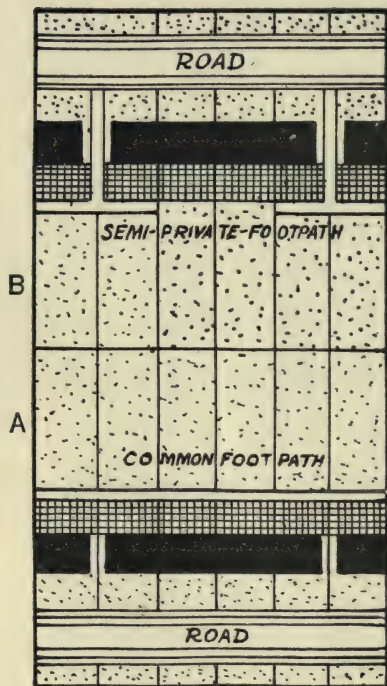


FIG. 130.—Back footpaths :
A, Continuous ; B, Non-continuous.

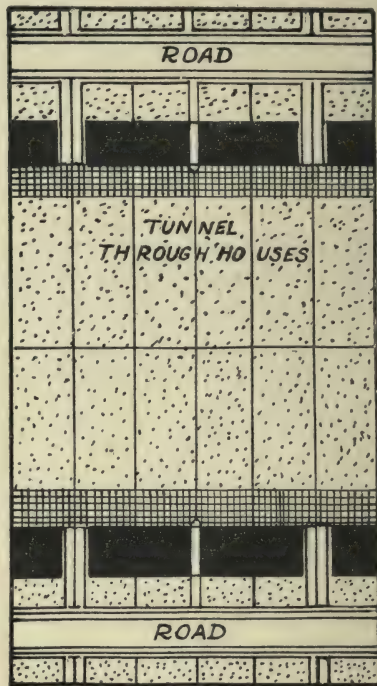


FIG. 131.—Back access provided by
tunnels through the houses.

which carts can back to receive the refuse or deposit the coal. This system is in use at Port Sunlight and is said to work efficiently, but it is open to the same objection with regard to the severance of the gardens and the perpetuation of the enclosed backyard as the preceding arrangement. On the positive side, however, it is appreciably less expensive, and as there is a common path round the garden

ground, it can be allotted according to the requirements of the individual tenants, and no one need be burdened with a garden he may not have the leisure or inclination to cultivate. A cheaper and scarcely less convenient plan is that illustrated in Fig. 130 (B), where the paths are not continuous but approach the middle houses from both ends of each block. Less open to the public gaze than in the case of the common footpath, the backyards are not enclosed and the gardens are separated from the houses only by a footpath that is private, except in so far as it is used by the dustman and the coalheaver. This method, though successfully operated in Sheffield, requires such a high degree of neighbourly feeling to work smoothly that it cannot be considered suitable for general application.

Passageways through the Buildings.—An entirely different solution, in which the back road is dispensed with altogether, is illustrated in Fig. 131. This system has, outside colliery districts, become thoroughly well established in all parts of the country. Access to the backs of the intermediate houses in a group is provided by a passageway through the building itself, serving two houses and affording in every case a direct means of approach from the front. Privacy, as complete as is possible under town conditions, is ensured to the gardens, and the enclosed backyard is rendered unnecessary. So far as cost is concerned, the saving effected by the elimination of the back road has, of course, to be offset by the extra cost of the passage through the house. Both these items will vary in different localities so that no precise comparison is possible, but when allowance has been made for the increased size of the bedrooms in the houses between which the passageway passes, or the extra bedroom it is frequently possible to give one of them, the balance will generally work out in favour of the latter. The objection which is sometimes raised, that these passages may become a source of nuisance,

is usually based upon experience of passages which communicate directly with the street and is not valid where, as in modern development, private front gardens intervene, particularly if the path leading to the passage is closed by a gate.

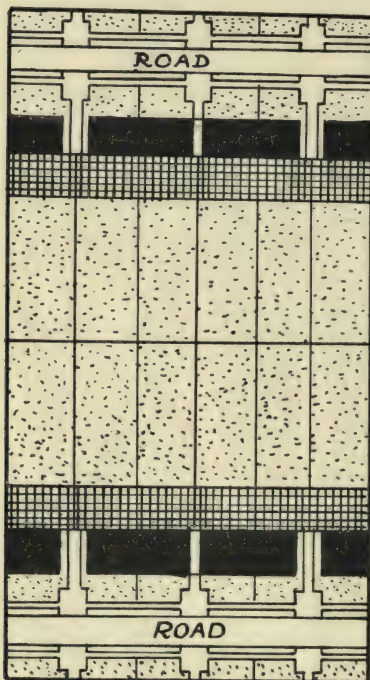


FIG. 132.—Where coal is delivered in bulk, paved recesses can be provided for its temporary accommodation.

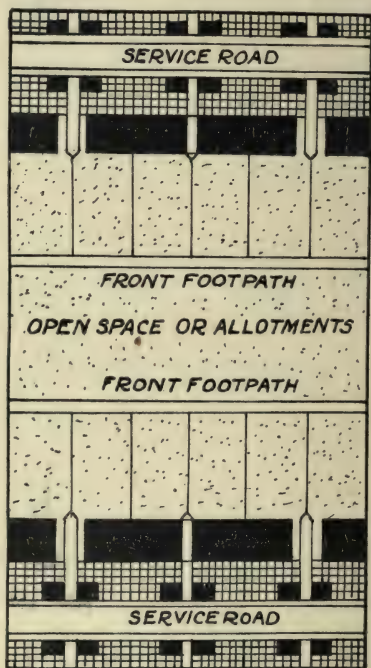


FIG. 133.—Coal and Ash stores grouped on service road.

Special Methods for Colliery Districts.—But while the arrangement just described is probably the best solution to the general problem which has yet been offered, it is not entirely satisfactory in colliery districts where it is customary to deliver coal in bulk. It might, perhaps, be suggested that it would be simpler to require that coal should be delivered in sacks than to invent new methods of site

planning to overcome satisfactorily the difficulties inherent in this method of distribution. And if it were only a question of delivery to private consumers there would be many arguments in favour of such a course. But the real

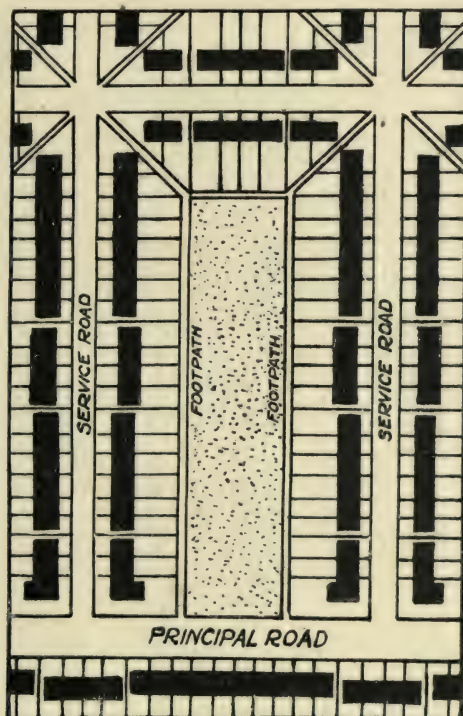


FIG. 134.—Arrangement, sometimes used in colliery districts, in which the houses back on to service roads and front access is provided by footpaths.

problem is represented by the coal distributed by the Colliery companies either gratis or as part wages to the colliers. In this case the coal is conveyed loose in lorries and tipped out on the ground for the collier to remove by his own efforts. The cost of putting the coal into sacks and of unloading them into the store would amount, for

the normal delivery of 15 cwt. to 1 ton a fortnight, to a considerable sum, and as it is extremely improbable that either the Colliery company or the collier would be willing to incur this expense, some other method of dealing with the matter has to be found.

The simplest plan is shown in Fig. 132, where the only modification to the normal arrangement of houses with passageways under them, is the formation, on both sides

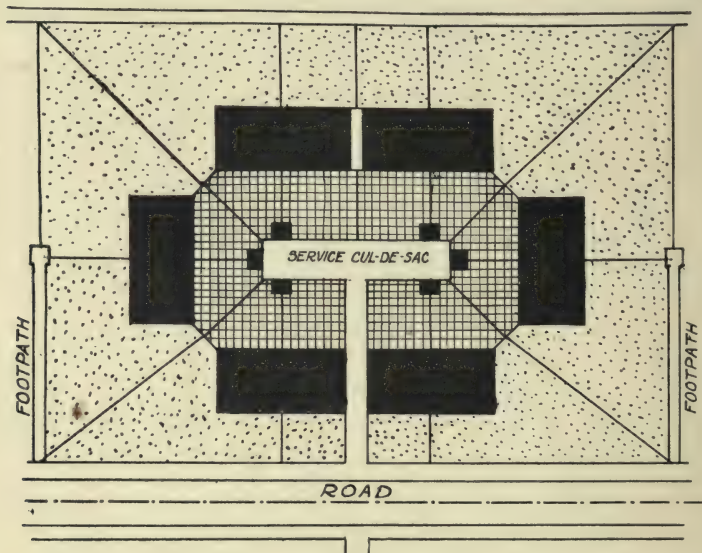


FIG. 135.—Arrangement suggested by Mr. S. P. Taylor for use in colliery districts.

of the path leading to the back premises, of a paved recess upon which coal can be tipped from the lorry without blocking the public carriageway or footpath. Where the lorry is provided with a chute for delivery direct into the coal-house—and this is undoubtedly the more satisfactory method—it would be possible to group the coal and ash stores in the manner shown in Fig. 133. Another system which has been advocated and is in use at Stainforth and

other places, is to make a widened back road the only means of access for vehicular traffic ; approach to the front doors being provided by a footpath only. This arrangement, with which, of course, it is possible to incorporate either paved recesses or grouped coal-houses, is illustrated in Fig. 134. It has the disadvantage that all minor streets would tend to be untidy and depressing, and employed on a large scale it would be unsatisfactory, but there are occasions when its limited use would be quite suitable. One point, however, decidedly in its favour, is that as the backyard replaces the front garden, the ground which is usually wasted in that position is used profitably and the available area of *private* garden is appreciably augmented. Fig. 135 indicates a more novel arrangement suggested by Mr. S. P. Taylor. Here the houses are placed in groups, facing outwards and backing on to an enclosed quadrangle upon which the ash and coal stores are situated ; access is provided by a short road leading from the public street. This is an interesting variation from the more stereotyped form of planning, and it would result, not only in completely screening the backyards from the public gaze, but also in considerable economy in the cost of development. As in the previous case, it is a system for special rather than general application ; but used with discrimination, it can be regarded as quite an effective solution to a difficult problem.

CONCLUSION

In considering the successive stages of our subject, it will have become increasingly evident that the effective application of those principles of housing estate development, the elucidation of which has been attempted in these pages, depends in large measure upon the co-operation of all those who, whether in a private, public, or professional capacity are concerned with the better ordering of their town. The social aspect of the problem has throughout

been regarded as the key to its technical solution. From the initial insistence upon the necessity of including Housing as an integral part of a comprehensive policy of urban development, through every process involved in the preparation of the Scheme to the final disposition of the buildings, the welfare of the community rather than the profit of the individual has been the first consideration. For it is clear that no system of development can ultimately be successful which does not make this its chief concern. The waste, squalor, and confusion which we deplore in so many of our modern towns, are directly traceable to the complete disregard of the common interest which, hitherto, has characterised the provision made for urban expansion, and there is no security against the perpetuation of these evils until the common interest is held to be of paramount importance in civic matters. This is the principle, therefore, upon which our plans and regulations must be based. But plans and regulations by themselves cannot achieve the regeneration of our cities. They are, indeed, essential, but they can never become effective unless they represent the conscious desire and unless they secure the active co-operation of the citizens for whose comfort and convenience they are intended to provide.

Civic Art is the expression of Civic Life. "I would not care a pin or a button," says Professor Lethaby, "for a showy city as such if it could be produced only outwardly, but I see that every town is a picture of the minds of its inhabitants. If the town does not embody rational effort, discipline, and aspiration, the children will be untrained and the men and women will be unsatisfied, hopeless, and anarchical—it must be so, for as the old Greek poet said, 'The City teaches the Man.'"

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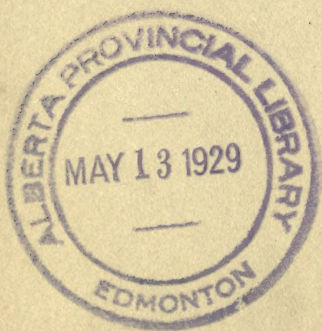
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